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FAIRBANKS' 200 TON AUTOGRAPHIC TESTING MACHINE.

THE engineer, when confronted with the question what material he shall use, answers it by another question, viz.: What will the material stand? Before beginning a work, therefore, having determined upon the materials and finished his designs, he will naturally be anxious that what he uses possess the qualities and strength upon which

combining two or more in themselves. We shall confine ourselves here to the description of a machine designed to test for tension, compression, and flexure.

In the description of this machine we are immediately led to notice a distinguishing feature, which until comparatively recently had not been adapted to them. We refer to the autographic record which they make, thus enabling us at a glance to judge of the qualities of the material tested. This very desirable object was first accomplished in a machine

applied, the elongation or compression, and must be so constructed that small or large pieces can be broken without injurious effects. There are numerous other points which we need not mention here, but which will be pointed out as they occur. To do all these things automatically, therefore, presents a difficult problem; how far this has been accomplished the following will show.

The general appearance of the machine is shown in Fig. 1, its action being similar to that of a platform scale,

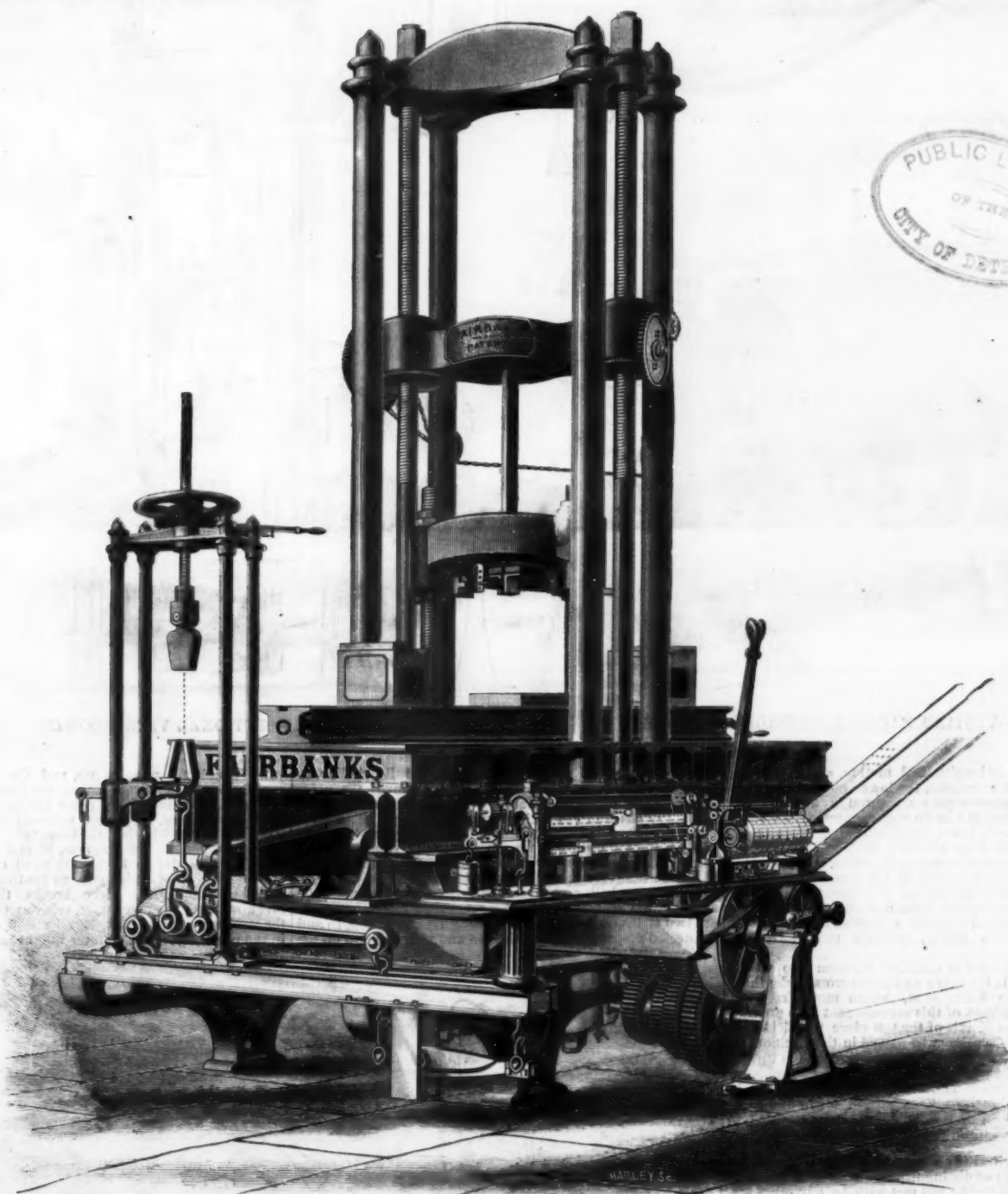


FIG. 1.—FAIRBANKS IMPROVED TESTING MACHINE.

his calculations were based. But both in the case of natural and manufactured materials the variations in quality are so great, that to judge a whole class by a single specimen is out of the question. This compels the engineer to test all the materials which go into a structure, and thus remove all doubt as to their qualities. This important consideration of testing is now so well recognized that hardly a single structure of importance is erected without tests, and in works of great magnitude they become an absolute necessity. The machines upon which they are made play a very important part in the construction of a work, being in fact the judges that decide the rejection or adoption of a material.

Among the various tests we might mention those for tension, compression, flexure, torsion, etc., and machines have been built specially for all these purposes, oftentimes, however,

for torsional tests, which was designed by Prof. Thurston, of the Stevens Institute of Technology, in 1876. The benefits derived from its use soon became apparent, and led to its adoption on testing machines for tension and compression, one outgrowth of which is the Fairbanks testing machine, which we are about to describe. One of these machines, with a capacity of 400,000 lb., is situated in New York city, where tests are daily made with it, under the superintendence of Mr. Arthur V. Abbott, its designer, to whose courtesy we are indebted for much information with regard to it.

Before entering into a description of the machine it might be well to state what the principal requirements of such a machine are, and following see how they are fulfilled. Briefly stated, the machine must measure accurately the stress

the load on the platform being indicated on the beam. The engraving differs a little from the machine we shall describe, as regards the shifting of the poise of the scale beam, the principle remaining the same, however. The platform is seen to consist of iron beams resting upon two pairs of double tees below them. The four outer uprights, bolted to the platform, carry a connecting piece which constitutes the bearings for the two screws on either side of the platform.

Fig. 2 is a sectional view of the machine, and shows clearly its principal working parts. The screws, A A, rest upon the beams, B B, which have bearings for the knife edges bolted to them on their under side. Each double beam carries two bearings, one at each end, thus making four altogether. It is evident, therefore, that any weight or pull on the up-

rights, *A A*, will be transmitted to the platform and shown on the scale beam.

The upright screws, *A A*, carry a crosshead, *B*, which can be raised or lowered by the crank, *A²*, and connecting gears; the object of this is to speedily accommodate the machine to various sizes of test pieces. During an actual test, however, the upper crosshead remains fixed. Coming up from below, will be seen two screws which reach about half way up. They are securely fixed at the

Fig. 5. The current coming down the test-piece, *S*, divides into two branches. One of these leads through the lower clutch into the electro-magnet on *w*, and thence to a pair of electro-magnets, *K*, which attract a hook, *K'*, the object of which will be explained later. The other branch starts from the lower crosshead and passes to the cylinder, *X*, Fig. 5; at that point, however, it divides into two branches, each one passing around the electro-magnets, *M*, *N*; their ends are then passed to a pin, *P*, and mercury cup, *C*, both of which are fixed on the upright at the end of the scale beam. The electro-magnets, *N*, *M*, operate independently, turning the cylinder backward or forward, according to which one is in action.

Fig. 2 is a perspective view of the scale beam. The top of the beam is a rack which gears with a pinion of the mechanism inclosed in the box-shaped poise. Within this

beam; the strips are insulated from each other. The electro-magnets within the poise take off the current from the strips by means of contact springs, thus permitting a free motion with constant electric connection. After passing through the magnets the wires join and return to the dynamo.

In order to bring the action of the machine clearly before the minds of our readers, we will suppose the poise, *L*, to be at zero, a test piece placed in the machine, and the power applied by shifting the belt; the latter is done by means of a rope which has a loop at its end passing over a hook which forms one arm of the lever, *K'*, the other arm being attracted by the magnets, *K*. The screws begin to revolve, the pull begins, and the scale beams rise. Connection is then made between the pin, *P*, and mercury cup, *D*; the current, therefore, flows through the magnets, *N* and *E'*, the cylinder turns forward, and the poise begins to travel

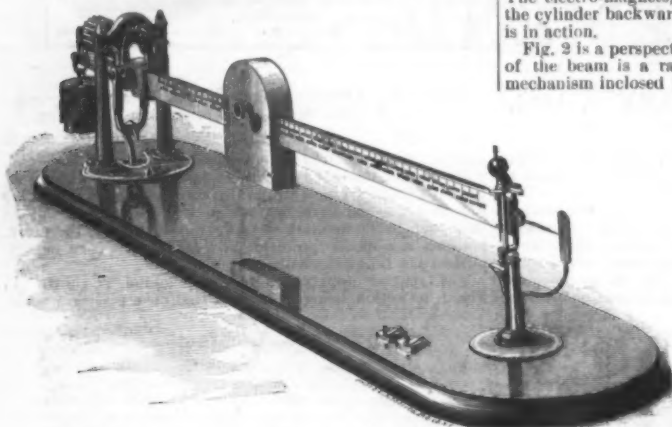


Fig. 2.—TESTING MACHINE SCALE BEAM WITH TRAVELING POISE.



Fig. 3.—TESTING MACHINE RECORDING CYLINDER.

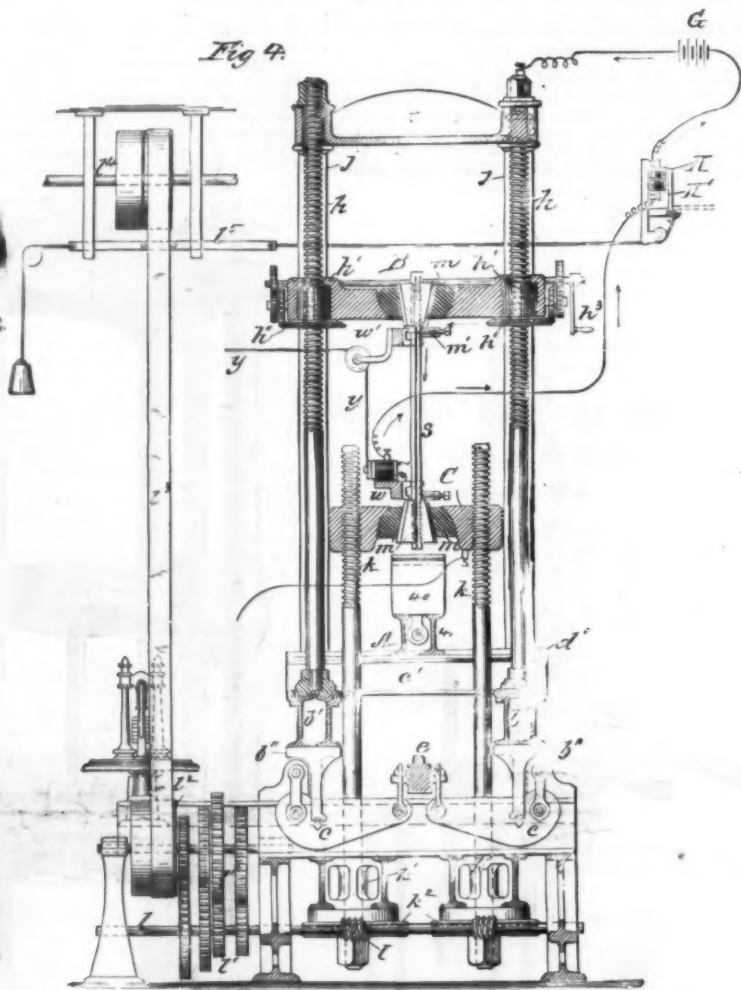


Fig. 4.—TESTING MACHINE.—SECTIONAL VIEW SHOWING WORKING PARTS.

bottom, to prevent any longitudinal motion, and carry between them a second crosshead, the lower one as shown in the figure. These screws pass up through holes in the platform, to which they are in no way connected; any turning of them will raise or lower the crosshead between them, and consequently anything attached to it. At their lower ends the screws carry worm gears, *k k*, which are both actuated by worm wheels, *l l*, keyed to the same shaft. This arrangement obviously insures an absolute uniform motion of the screws, an essential feature of success in the machine. Power is applied through a combination of multiplying gears, giving a steady, uniform motion to the screws.

The piece to be tested is clutched between two wedge shaped jaws, *m m'*, in the upper and lower crossheads; these jaws are fitted into balls, *m m*, which move freely in their sockets. The object of this arrangement is to provide for always having the *X* axis of the test piece parallel to the line of stress. If the specimen be placed in the machine out of line, the first stress applied will cause the balls to turn in their sockets until the piece is in line.

Having fixed the specimen, the screws, *k k*, are set in motion, and in so doing draw the crosshead down, and exert a pull upon the specimen, *S*. This pull is transmitted to the platform by the *X* uprights, *A A*, and thence to the scale beam.

Having thus described the general action of the machine, we now come to its most distinguishing features, which give to it a peculiar individuality not met with in any other machine of its class. We refer to its automatic properties, in virtue of which the machine gives a complete and exact record of the load, extension, or compression, and several other details of prime importance. These very desirable objects are performed with the aid of electricity, the generator being a small dynamo, not shown in the engraving.

The record of the machine is drawn upon profile paper stretched upon a cylinder, Fig. 3, and the elongation is measured in the following manner. By reference to Fig. 4 it will be seen that the test-piece, *s*, is clutched by two arms, *w* above and *w* below. The upper one carries an insulated pulley over which a steel tape, *y y*, passes; the latter ends in a round disk, which is firmly attracted by an electro-magnet on the lower clutch. Any elongation which the piece experiences will, therefore, pull the steel tape down at exactly the same rate. If we imagine the tape connected with the pen on the cylinder, Fig. 3, its motion will trace a line of the same length as the stretch—which can thus be measured.

The recording of the load applied is a little more complicated; we will begin by giving the electrical connections,

box there are two electro-magnets, *E* and *E'*, similar to those in the cylinder. The action of one moves the poise forward, the other backward. At the lower end of the beam there is seen projecting downward a pin, *P*, which, when the beam drops, dips into the mercury cup below it, *C*, Fig. 5. Opposite the pin on the upper side, the beam carries a mercury cup, *D*, into which a fixed pin, *P*, dips when the beam rises. The engraving shows this pin passing through a ball, and it can be fixed so as to regulate the swing of the beam. On the reverse side of the latter, there are two strips of brass, *A A'*, running its entire length and connected respectively with the pin and mercury cup on the

out. The beam remains up, and the poise travels until equilibrium is established; then the former stands midway, and both the cylinder and poise are stationary; as soon as the load increases, they begin to travel again; if on the contrary the load diminishes, the beam falls, makes a connection between *C* and *P*; the magnets, *M* and *E*, operate, and the poise and cylinder go backward, until equilibrium is again established; all of which goes on continuously.

When, finally, the piece breaks, the electric circuits break with it; the magnet, *w*, releases the disk attached to the steel tape; the magnet, *K*, releases the lever, *K'*; the loop in the rope unhooks, a counter weight shifts the belt to the

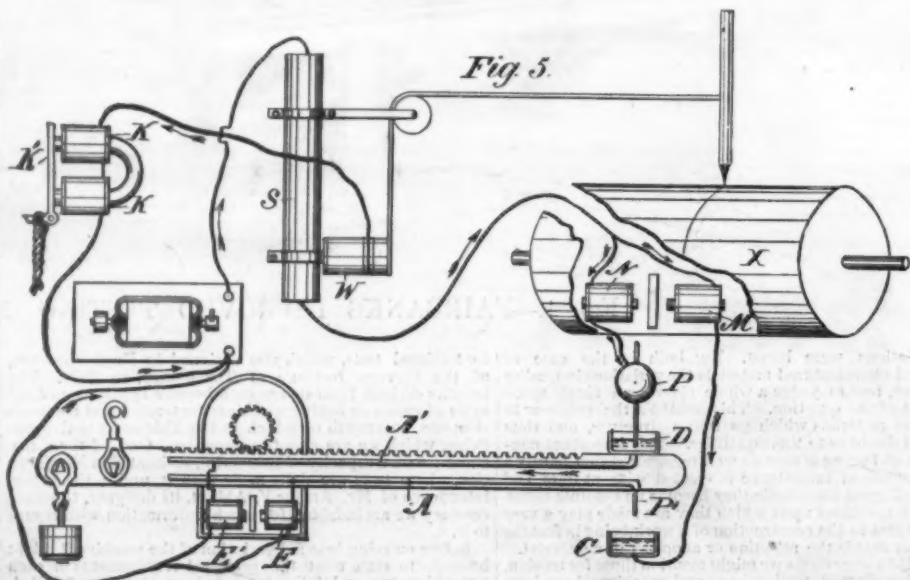


Fig. 5.—TESTING MACHINE.—THE ELECTRICAL CONNECTIONS.

loose pulley, and the machine stops. We need hardly say, that the actions just enumerated occur almost instantaneously. The position of the poise on the beam gives us the weight at which the specimen broke. And since the poise travels in unison with the cylinder, the distance through which the latter turns measures the weight, while the elongation occurring at the same time draws the pencil at right angles to this line. The result is therefore a curve drawn upon the profile paper, the abscissas representing the elongation, and the ordinates the load. If the piece tested be of good quality the curve drawn will be smooth, showing that the elongation occurred at the same rate as the increase of load; if the piece be poor and of uneven composition, the curve will show a more or less ragged appearance.

It will now be seen why it was necessary to split the circuit into two branches at the bottom of the test piece. The reason is, that the magnets, ω and K , require a constant, unbroken current, whereas the vibrating beam caused constant breaks. The disk being released from the magnet, ω , frees the steel tape and thus prevents injury, which an undue shock might give to the cylinder mechanism.

Although not shown in the engraving, the machine can be arranged to test pieces up to 30 feet in length, thus rendering it valuable for testing eye-bars up to 8 sq. in. section. It can also be worked without the automatic action, and levers which are close at hand can stop, start, and reverse it, and change the speed of working.

The regularity and precision with which all these various actions are accomplished are astonishing, and reflect great credit upon the designer.

A NEW CATHETOMETER.

SOME time since I received from the University of Modena an order to construct an instrument for exact measurement



IMPROVED CATHETOMETER.

in connection with the phenomena of capillarity. Its primary object was to measure accurately a difference in level of about 10 cm. I proposed at first to construct Pfaundler's microscope cathetometer, which was described in the *Centralzeitung für Optik und Mechanik*; but this was found to be impracticable, because the fluids whose capillarity was to be measured were surrounded by hot vapor of water, which would have exposed the objectives of the microscope to too high a temperature. Objection was also raised against the columns upon which the microscopes slide, on account of their shortness.

I therefore designed a new instrument, the construction of which is very simple, and which seems to answer perfectly the purpose for which it is intended, and can be used to advantage in all cases requiring the measurement of small differences in level. I would like to name the instrument the "screw cathetometer," because the measurements are made by means of a micrometer screw. A short description in connection with the accompanying engraving will suffice to make its working clear.

The instrument consists of a square bar of steel carefully made, and mounted upon a tripod with leveling screws. Surrounding the bar is a sliding sheath, H , about 24 cm. in length, which can be clamped to the steel bar by the set screw, K , the fine adjustments being made by the micrometer screw, N .

At its left hand lower end the sheath, H , has a horizontal projection which supports a telescope, F ; the latter is capable of fine adjustment both horizontally and vertically, and is provided with a delicate level and mirror, shown above it. The two oculars which accompany the telescope are provided with cross-hairs, and have a magnifying power of 20 and 40 diameters respectively.

Sliding over the sheath, H , is another, H' ; this latter has a projection at its lower right hand edge, which supports a telescope exactly like the one just described. The sheath, H , is moved by a micrometer screw, M , conveniently situated, and which is made with the greatest care; the whole num-

ber of revolutions are read off at the scale, S , while the fractions of a turn are indicated by the head of the screw, which is graduated into 100 parts. The construction is such that when both telescopes are on the same level the readings both of the scale and screw-head are zero.

Both sheaths are balanced by the weights, G , in order to facilitate the working of the instrument, and to relieve the micrometer screws of strain. In order to take measurements we must know the exact pitch of the screw, M , in millimeters. In the instrument just described its value was 0.3292 mm. or nearly $\frac{1}{3}$ mm. Supposing the screw to be without error, and that the fifth part of $\frac{1}{3}$ of a revolution can be conveniently noted, it would follow that a difference in height of 0.0006 mm. could be measured. Such a degree of accuracy, however, cannot be attained, as the errors of observation alone would exceed that amount.—*F. Miller, in Zeitsch. für Instrumentenkunde.*

THE FALL OF THE DOUARNENEZ BRIDGE.

A DEPLORABLE accident lately took place at Douarnenez, a small coast town of Finistère, which is situated on the bay of the same name.

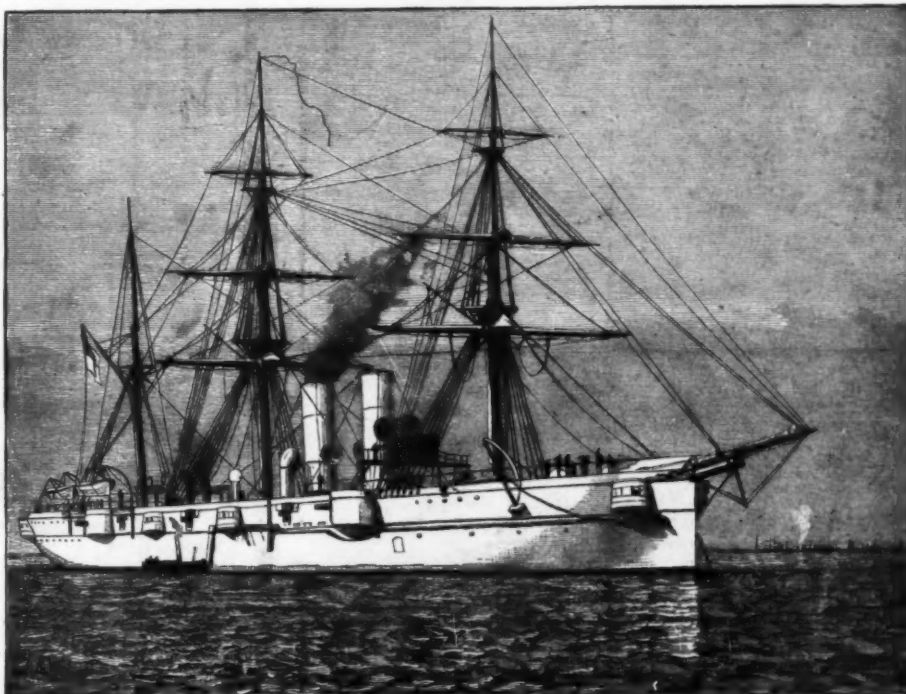
The bridge, which was in course of erection over the river, broke last week. It had a total length of 580 feet, being 195 feet from pier to pier. On the morning of the accident work had progressed to within four meters of the second pier, when suddenly, toward nine o'clock, a loud crash was

heard, the truss broke off close to the first pier, and the men upon it were thrown into the river. Assistance immediately arrived, and they were all saved with the exception of one, who, unfortunately, died a short while after, of the wounds received in the fall.

Our engraving shows the appearance of the bridge a short while after the accident, and is from a photograph taken at the scene of the accident.—*L'Illustration.*

H.M.S. LEANDER.

This new ship, with the *Phaeton* and *Arethusa*, under construction by Messrs. Napier & Sons, of Glasgow, is an example of a class in which some provision has been made to compensate for the absence of armor plating by watertight subdivisions, and by placing the coal so as to protect the vital parts of the ship; but she is also fitted with a defense against vertical shell fire, in the form of a steel protective deck, 1½ inches thick, extending over the engines, boilers, magazines. The armored deck is to be slightly below the level of the water at the middle line, and curved down so as to be considerably below it at the sides. There is increased space for stowing coal. The engines, also by Messrs. Napier, are to be twin-screw, horizontal, surface condensing, with high pressure, and with all the latest improvements, to develop collectively 5,000 indicated horse-power. With this, however, a speed of sixteen knots is anticipated; but



NEW BRITISH SHIP OF WAR LEANDER.

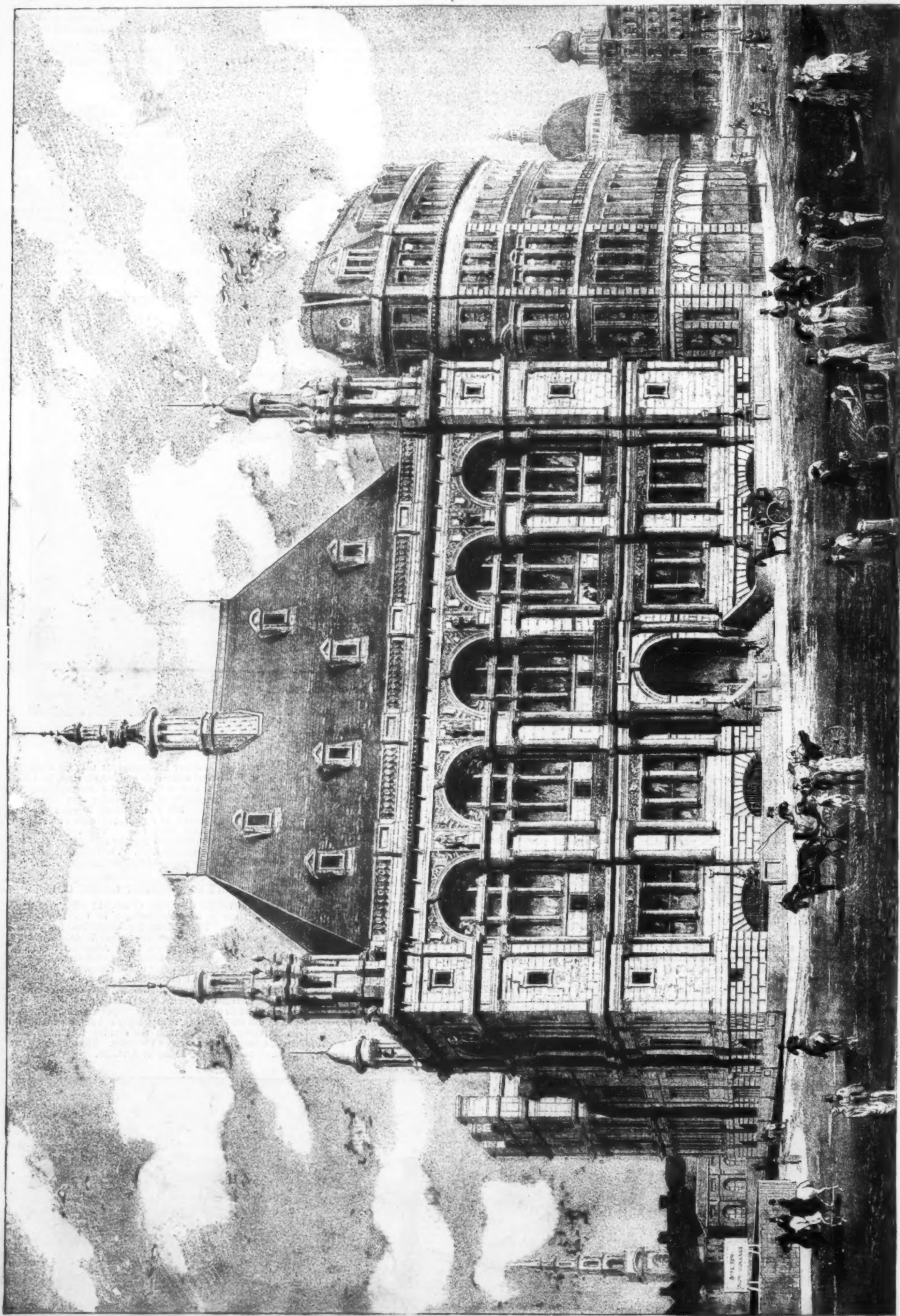
it is possible that hereafter arrangements may be made for working with a closed stoke hole and forced blast, in which case a speed equal to that of the *Iris* and *Mercury* may be obtained. The dimensions of the *Leander* are: length between perpendiculars, 300 ft.; extreme breadth, 46 ft.; draught of water forward, 17 ft. 6 in.; draught of water aft, 20 ft. 6 in.; displacement, 3748 tons. The armament will consist of eight six-inch breech loading rifle guns, and two revolving guns of the same caliber. The *Leander* is also well supplied with machine guns.—*Illustrated London News.*

DISCOVERY OF ANCIENT GREEK COINS.

A VERY interesting discovery of ancient coins was made some time since in the neighborhood of Carystos, in the island of Euboea. In preparing the foundations for a house there were found in an earthen vessel over 70 Athenian tetradrachmas of pre-Roman times, three Athenian drachmas, and 30 drachmas of Carystos itself. One of the tetradrachmas has in the inscription the name of the *demos*, and is believed to be a unique specimen of the kind. Between the death of Alexander and the Roman domination, the coining of money used to be intrusted at Athens to certain selected persons, who introduced their own names into the superscription; but this case would indicate that, occasionally at least, for some particular reason, the *demos* took the coining into their own hands, stamping the name on the coins. Most of the other tetradrachmas bear the names of Archons.



DOWNFALL OF THE BRIDGE AT DOUARNENEZ, FRANCE.



THE CITY OF LONDON SCHOOL, VICTORIA EMBANKMENT.

"HAPPY NEW YEAR!"

THE annexed engraving, which we have taken from the "Meisterwerke der Holzschneidekunst" (Masterpieces of Wood Engraving), explains itself. But it will not be inappropriate to devote a few lines to the artist. Knut Ekwall was born April 3, 1843, at Saby, in the Swedish Province of Smaland, and was educated in the years from 1860 to 1866 at the Academy of Arts in Stockholm. From that time to 1870 he occupied himself with drawing and engraving on wood. In 1870 he went to Germany; he first remained at Munich, but later on made Leipzig the headquarters. Here he furnished many elegant illustrations for the *Illustrirte Zeitung*. He now resides in Berlin; he is a pupil of the celebrated artist L. Knaus.

THE CITY OF LONDON SCHOOL.

THE site of the City of London School is an irregular oblong, having a frontage of 136 feet facing the Embankment, and a depth next the new side street of more than 430 feet. It becomes wider as it recedes from the Embankment. It is bounded on the east by the lofty flank wall of the Royal Hotel, and on the back or north side by some vacant building

land belonging to the Corporation next Tudor Street. The site, which was placed at the disposal of the School Committee by the Corporation, has been valued by independent surveyors at £95,000.

The surface of the site of the building is entirely composed of made ground, which has been filled in at various dates at the back of retaining walls, as successive belts of the foreshore have been reclaimed from the river. All the foundations of the school building are carried to an average depth of 28 feet below the level of the school playground, and large rectangular holes were sunk through the made ground down to a bed of Thames ballast, which was met with at that level over the whole site, and which doubtless formed at one time the bottom of the river. The holes were then filled in with Portland cement concrete up to a level of 30 inches below the surface of the playground, so that the school building stands on a series of concrete monoliths more than 25 feet high, and ranging from 10 to 15 or 16 feet square. The foundations of the gymnasium, latrines, and boundary walls are carried to a small depth only, and rest upon compact made ground, which has doubtless been in position for a century. These outbuildings being by no means heavy, are carried by a wide bed of concrete resting on this made ground.

The whole of the floors throughout, except those to the porter's bedrooms in roof, are fireproof, consisting of Portland cement concrete, filled in between rolled iron joists, which are spaced about 27 inches from center to center. The lintels throughout are made up of rolled iron joists, and an unusually large amount of constructional iron work in girders and columns has been employed at the level of the ground floor, so as to avoid obstruction in the covered playground, which occupies so large a portion of the basement beneath the building. Some of the columns and girders have very heavy work to perform, the column in the cloak-room, for instance, and that in the dining-room, having each to bear a load of nearly 300 tons.

The block plan is of the simplest character. The building is L-shaped. The shorter arm of the L, facing the Embankment, is three stories high, and contains the great hall on first floor; the administration-rooms and library on ground floor; covered playground on basement. The longer arm of the L, facing the new side street, which leads back from the Embankment to Tudor Street, is the teaching block, and contains natural science school and lecture-hall, and two class-rooms on second floor; eighteen class-rooms on first and ground floors; hat and coat room, dining-room, and covered playground on basement; the gymnasium and



"HAPPY NEW YEAR!"—DRAWN BY KNUT EKWALL.

latrines are detached buildings in the playground. A common-room and ante-room for assistant masters, a kitchen with its appurtenances, and apartments for the resident porter are provided in suitable places.

The exterior of the hall block facing the Embankment is constructed entirely of Portland stone, but the columns of the windows have polished red granite shafts. It is in the style of Italian Renaissance enriched with carving and sculpture. The Embankment front of the building is 120 feet long, having an ornamentally treated flanking tower at each corner, and a slightly projecting central entrance under a porch. A wide flight of steps leads up to this porch from the Embankment, and there are a series of balconies at the level of the great hall floor. The composition is three stories in height, the basement consisting of large segmental-headed openings filled with iron grilles inclosing the covered playground. The ground floor has three-light square-headed windows divided by columns. The first floor windows have arched heads, and are deeply recessed. The tympana beneath these arched heads are filled in with allegorical seated figures representing various arts and sciences, and the wall spaces between these have square-headed niches containing portrait statues of Bacon, Sir Thomas More, Shakespeare, Milton, and Newton.

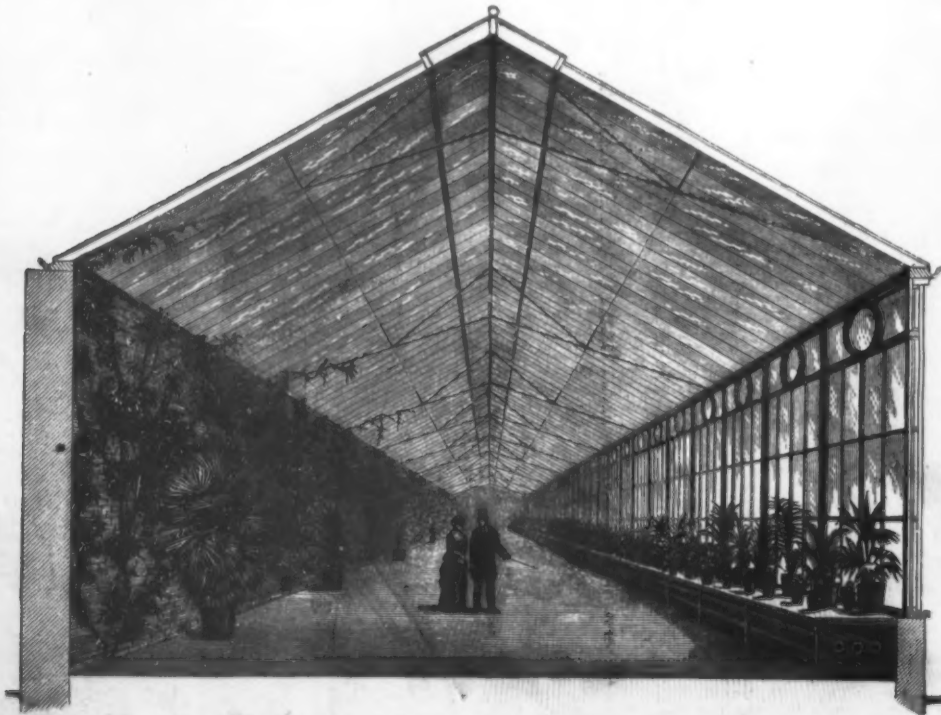
The facade is crowned by a balustraded stone parapet. Above this rises the great hall roof, which is a high-pitched roof of French character, covered with green slates and surmounted by a central flèche. This flèche, which forms the crowning central feature of the design, acts as the ventilator of the great hall. One object which this high roof serves is to prevent the school being overpowered by its gigantic next-door neighbor, the Royal Hotel. At the northwest corner of the hall block a smaller turret rises, which is surmounted by a stone bell-cot containing the school bell. This forms the flanking feature of the west end of the great hall next the side street.

The exterior face of the teaching block next the side street and the whole of the exterior of the building facing the playground is of very plain character, being faced with white brick and having stone strings and cornices and dressings to the windows. The outside of the lecture-hall on the second floor at the extreme north end of the teaching block rises above the adjoining buildings, and forms the flanking feature at the extreme north end. A low stone balustrade wall incloses the irregular forecourt, which is laid out as a garden on top of the railway tunnel next the Embankment, and is continued along the west front of the teaching block next the side street.

The architects of the building are Messrs. Davis & Emanuel, whose design was adopted in competition. The water-color drawing from which the illustration is taken was exhibited this year at the Royal Academy.—*The Architect.*

NEW CORRIDOR, ROYAL BOTANIC GARDENS, REGENT'S PARK.

The old corridor in which the spring shows had been held for some years was only 16 feet wide, and consequently too narrow either to exhibit the plants to the best advantage or to allow of easy locomotion on a show day. The new structure, of which we give an illustration, is 25 feet wide and 200 feet long, including the entrance lodge. It is 12 feet high at the sides and 20 feet at the ridge, having continuous ventilating sashes on both sides of the ridge, which open in lengths independently. Every alternate ornamental sash at the top of the glass side can also be opened, and both roof and side ventilators are worked by rod and lever gearing with improved screw slides. The roof, which is supported by neat wrought iron tie rods, and the top side lights are glazed with Hartley's rolled plate glass, the side being glazed with 21 oz. sheet glass. Every spar and sash bar in the roof is guttered to carry off condensed moisture, and the house is heated by six rows of 4 inch piping along the front, worked by a new wrought iron terminal end saddle boiler. A great improvement made in the conservatory at the same time is the enlargement of the stove to the extent of a space about 40 feet by 30 feet, by shifting a glass partition. The works, which were carried out by Messrs. James Boyd & Sons, of Paisley and London, are now complete, and the corridor has already been made gay by Mr. Comber with a large collection of chrysanthemums.—*The Gardeners' Chronicle.*



THE NEW CORRIDOR IN THE ROYAL BOTANIC SOCIETY'S GARDEN, REGENT'S PARK.

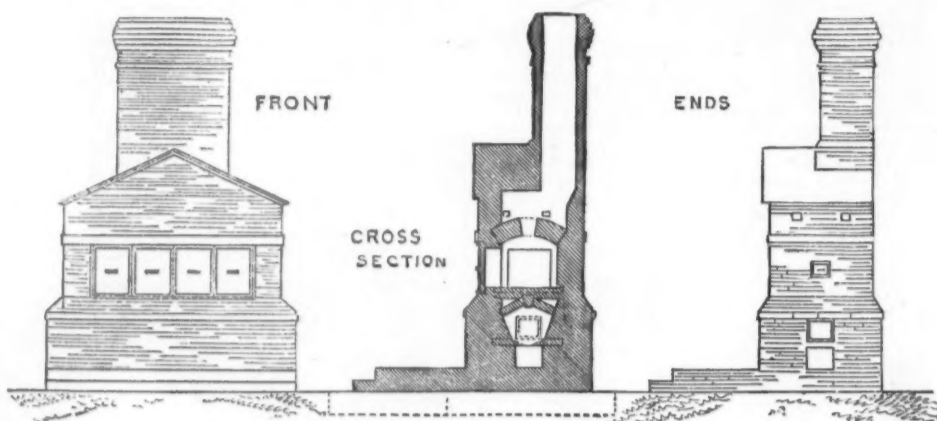
A CREMATORIUM.

We illustrate herewith the crematorium recently used at Wimborne Minster. The building is of solid brickwork, and every part exposed to the fire is lined with firebrick. The fire in the furnace chamber rests on stout pierced plates of cast iron, with a continuous flue under for the admission of air and the reception of ashes and debris. The top of the furnace chamber is formed with firebrick, one brick laid as a stretcher forming the keystone of a rough arch with six intervals, and over this two courses of firebricks with intervals alternating with the lower openings, to allow the flames to ascend from below. The bottom of the cremation chamber is thus formed of one narrow ridge—namely, the fire-

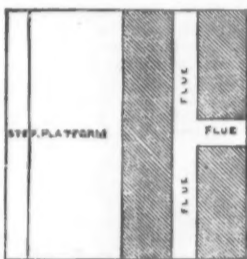
person in charge may from time to time be able to see what is going on inside the chamber; these also are closed with firebrick.

Over the cremation chamber is another void or chamber, connected with the cremation chamber by three flues 9 inches square. This is so placed to prevent the too rapid escape of the heat, etc., and to provide a place where the gases generated in the chambers below may be consumed, having apertures for the admission of the air, which is necessary to produce proper combustion. The whole building is surrounded with two bands of very stout iron.

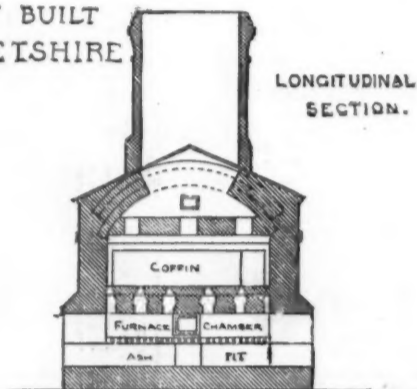
In the recent cremation, while the gases were collecting in the above chamber a thick smoke issued from the low chimney, but as soon as the firebrick door was opened and the



CREMATORIUM RECENTLY BUILT
& USED AT MANSTON DORSETSHIRE
DECEMBER 1883



PLAN.



LONGITUDINAL
SECTION.

SCALE FEET.

brick keystone already described, with firebrick ribs between, supporting the firebricks on which the coffin rests.

The few ashes that remain after cremation rest on these firebricks or on the sloping surface between them, so that, although the fire has full access to this chamber through the openings under the ribs, the ashes are prevented from falling through into the furnace. One side of the cremation chamber is left open for the introduction of the coffin. This is afterward closed by means of firebrick lumps 4 inches thick in wrought iron frames made air tight with fireclay, and fixed in much the same manner as the blocks that close the mouth of a gas retort. There is also a similar firebrick door at each end of the furnace or fire flue.

There are also four small openings in the cremation chamber, one at each end and two at the back, so that the

necessary amount of oxygen had been admitted to produce combustion, the flames from this chamber ascended several feet above the top of the chimney and remained burning for some time.

The crematorium was erected by Mr. Richards, of Wincanton, who is a well known authority on heating, etc.

We take the foregoing from the *London Building News*. In this country the best known establishment for the cremation of the dead is the Le Moyne Crematory, in which the body of the late Dr. Charles E. Blumenthal, of New York, was lately cremated. It is situated near the top of Gallows Hill, two miles from the town of Washington, Washington County, Pennsylvania. It is a small one-story brick building, with two rooms—one used for the reception of the body, and the other containing the fumacea retort. On the small grass plat in front of the building is a small monument to the memory of Dr. Le Moyne, the founder, whose body was cremated here.

A body, to be cremated on its arrival, is taken into the reception room, and, as prepared for burial, is wrapped in a sheet of white muslin saturated with a strong solution of alum, and is then placed on an iron frame or crib.

The furnace is very similar to a gas retort and is of fireclay, with no opening except the door. The fire is started in the fireplace below and does not reach the inside of the retort, and takes twenty hours to bring it to the proper heat, which is what is known as a white heat.

The body having been wrapped in its winding sheet and placed upon the iron crib, is thrust into the retort. Immediately the sheet is consumed and falls gently around the body, forming as it were a coating or covering of a glassy nature. The door is then closed tightly, and in two hours the body is reduced to ashes, which, after twenty hours to allow the furnace to cool, are collected and disposed of according to directions. A full sized person will become about four pounds of ashes.

The fee for cremating is forty-five dollars. Every precaution seems to be taken to prevent its being used as a cover for crime.

A correspondent of the *Philadelphia Ledger* says: "A person having been the witness of one cremating ceremony, does not want to see another."

ANCIENT CHINESE COINS IN BRITISH COLUMBIA.

In the summer of 1882 a miner found on De Foe (Deorse?) Creek, Cassiar district, Br. Columbia, thirty Chinese coins in the auriferous sand, twenty-five feet below the surface. They appeared to have been straggled, but on taking them up the miner let them drop apart. The earth above and around them was as compact as any in the neighborhood. One of these coins I examined at the store of Chu Chong in Victoria. Neither in metal nor markings did it resemble the modern coins, but in its figures looked more like an Aztec calendar. So far as I can make out the markings, this is a Chinese chronological cycle of sixty years, invented by the Emperor Faungti, 2,637 B.C., and circulated in this form to make the people remember it.—*James Deane, American Naturalist.*

COLORING LANTERN TRANSPARENCIES.

T. J. Houston, in the *Br. Jour. of Photo.*, says: When I prepare photographic transparencies for coloring, I do not treat them in precisely the same way as if I intended them to be used without color. If you examine a fine slide, by any well-known maker, embracing rural scenery with much foliage, it will be found that whereas in nature the foliage was green, of a hue more or less bright, in the photograph it is seen to be many shades darker than it should be, owing to the number and density of the atoms of silver composing the foliage, this being the case to such an extent as to prevent the green pigment from showing at all. In some transparencies of this description I have piled upon the foliage layer after layer of my brightest green without any colorific result having been attained, the heavy, somber, unnatural effect remaining as before.

This is altogether a different matter from painting a photograph on paper or porcelain; for in these the blackest foliage or heaviest shadows can be lighted up at pleasure by the employment of opaque or body colors, or by mixing a little flake white with the transparent pigments which alone are applicable to transparency painting. But if in a transparency recourse were had to this procedure, it would make things worse than before, for the luminous equivalent of flake white when applied to paper is, in a transparency, the thinning of the deposited silver so as to allow more light to be transmitted—the touch of pure white given to form the highest light in the one finding in the other its equivalent in the complete removal of the image by the needle-point or penknife, so as to leave nothing but bare glass.

To one who has had some experience both in making and coloring transparencies it is not difficult to obtain the best class of photograph for receiving colors with effect, although it may prove difficult to describe the characteristic features of such a photograph. Perhaps the best idea will be conveyed by saying that it ought to be "outline," and even its outlines should not be too dense. A very brief exposure and rather long development afford the keynote to the nature of the manipulations requisite to secure the best effect. Plates prepared by the old-fashioned tannin process, and developed by acid pyro, and silver, give an effect peculiarly well adapted for receiving color in the highest style of the art; but the exposure must be short and the development forced. When the picture is laid face down on a sheet of white paper, the appearance presented should be that of a properly printed proof upon paper, while the intensity, when raised up and looked through, must show a sufficiency of vigor.

Having obtained a suitable transparency, it must next be varnished. Some years ago I adopted the use of a varnish composed of sandarac dissolved in methylated spirit. It gave a clear, bright film, and both oil and water colors took to it nicely; but I sometimes had occasion—as every painter of lantern slides will have to do more or less frequently—to pick out bits, and put in, or rather take out, touches of high light by means of the needle-point. I found, however, to my extreme dissatisfaction, that the collodion film would chip and break off round the spot upon which I operated, and that if I drew fine lines by my scratch-point they became jagged and broken. Being recommended to try white hard spirit varnish diluted with alcohol, I did so with a result even worse than before. Having read in one of the *British Journal Photographic Almanacs* of the virtues of castor oil when added to a plain sandarac varnish, I tried it with excellent effect.

I have also employed, with the greatest degree of success, a solution of albumen composed of the white of an egg beaten up with twice its volume of water together with ten drops of ammonia. After the frothy mass has settled, the clear liquid is poured off. To use it the transparency is flooded with the liquid, which is then drained off at one corner and the picture immediately immersed in a tray of hot water, the temperature of which is but little under the boiling point. This coagulates the albumen, leaving it not only of a glassy degree of brightness, but modified in such a manner as to render it unaffected by either water or oil paints, while it is susceptible of the most delicate touches of another class of pigment, which I shall describe before concluding.

The question now arises: What class of colors is best for transparency printing—oil, water, or varnish? This cannot easily be answered; each has its own advocates. They are all good in their way, and there are some transparency artists who employ them all even in one picture. As oil pigments appear to enjoy the greatest amount of popularity, I will speak of them first of all. Although nearly every dealer in lantern appliances keeps boxes of colors for sale, it will be advantageous, especially for the beginner, to purchase from artists' colormen, under their definite names, the various colors required. They are conveniently put up in tubes and are sold at a very low price—fourpence and upward. It must also be noted that only very few pigments can be employed, owing to the paucity of such as are quite transparent; hence the expenditure for an outfit is very small.

For blue, *Prussian blue* forms the most useful among all the blue pigments, and one can get along very well indeed without any other, although there are some subjects in which *Payne's gray* comes in handy. There are other transparent blues, such as *Chinese blue* and *cyanine blue*; but the Prussian is susceptible of such easy modification by the admixture of others that no other is really required. The best yellows are *gamboze*, *Italian pink*, and *yellow lake*. There is but little difference between the two last, although the former of them is probably the more advantageous. The *gamboze* is useful for foliage, and with a small proportion of Prussian blue forms a good green. Both *raw* and *burnt sienna* must be procured. The former is useful in the representation of light, dry, sandy earth, dry roads, and light-colored houses; the latter is a very transparent brown of an orange tint. Both *Vandyke brown* and *burnt umber* are useful, but much less so in a photographic transparency than in other classes of work, because any subjects which were of these tones in nature will be represented so very darkly in the photograph as to require scarcely any coloring at all. *Crimson lake* and *pink madder* complete the list. The latter by itself dries very slowly, but by the admixture of megilp or mastic varnish its drying is quickened. This applies also to the Italian pink. A tube of *lampblack*, by which to render any portion more or less opaque; a tube of megilp, for use as a vehicle; and a bottle of mastic varnish and pale drying-oil, together with a few sable brushes, a palette, palette-knife, and large camel's hair brush complete the outfit.

The most important piece of work in the painting of a lantern landscape being the sky, I close this article by describing how it is done, premising that I do all my painting upon a retouching desk, which I find to answer this purpose rather better than the easels specially prepared for transpa-

rency painting. Let us imagine that the subject is a landscape having about two-thirds sky, into which a tree and a spire project upward. Mix on the palette a little burnt sienna and pink madder, and, having charged a brush with this, draw it in streaks across the sky a little above the horizon, and then laying down the brush dab it all over with the point of the first or second finger until it presents a uniform appearance. Never mind the fact that the paint has been carried over the tree and the spire; it must be removed from them by a pointed piece of soft wood as the last operation of all. Next apply to the upper portion of the sky some Prussian blue, and in doing so remember that there is no use whatever in hoping or attempting to make it quite uniform by means of the brush alone. The finger is the all-potent instrument by which uniformity is secured, and dabbing with it must be had recourse to. Bear in mind that the sky is of a deeper hue at the zenith than near the horizon; therefore let the dabbing be performed in such a manner as to retain more of the paint at the top than lower down, the quantity being so attenuated by the time it descends to the warm layer already applied as to merge into it quite imperceptibly. The laying on of a uniform sky seems, like playing the violin, very easy to the onlooker; but it is only by dint of several trials, carefully made, that success is attained. As the beginner will probably spoil several skies before he succeeds to his own satisfaction, a soft piece of calico dipped in spirits of turpentine will be a useful aid to him during his novitiate.

To complete the blending of the colors, and to obliterate the slight textural markings arising from the rugosity of the finger-point, is the function of the large camel's-hair brush of which I have already spoken. It must be whisked very lightly over the surface; and, if cleverly done, all surface asperities will disappear, and the coloring look as if the glass were stained. Until the sky presents such an appearance the formation of clouds must not be thought of.

IMPROVEMENTS IN PHOTO-BLOCK PRINTING.

We propose to say a few words on improvements made on the subject of producing photo-printing blocks by the etching process. For it must be borne in mind that in most of the so-called *photo gravure* processes the necessary high relief is obtained either by etching or by electrolytic, although it is true in the Woodbury and Waterhouse methods this is not the case.

The etching methods yields photo printing blocks in a much shorter time than does the electrolytic plan, and of late it has become possible to produce very good portrait blocks by etching, as witness the methods of Klic and others. Not very much, however, has been published on photo-etching methods, and therefore it is matter for congratulation that the Chief of the Vienna Ordnance Survey Office, Major Volkmer, has recently made known the results of some successful work which has been undertaken in that establishment under the auspices of Herrn Marriot and Sommer.

The great difficulty in half-tone, photo-block printing is, obviously enough, to secure a fine grain. All kinds of experiments have been undertaken, such as the crystallization of salts upon a glass plate, etc., but it has been found in the end that the best grain of all is that obtained naturally, in a collotype plate—that is to say, by the "wrinkling" of the gelatine film. An ordinary collotype plate is exposed to diffused daylight, and is thus uniformly acted upon by light; the washing to which it is subsequently submitted brings about the "grain-wrinkling" without further ado. If now, a fatty ink is applied, a uniformly gray surface is produced, which, if carefully scanned, will show a very fine grain, as do all collotype or Lichtdruck plates. A practiced collotypist has little difficulty, indeed, in obtaining a coarse or fine grain as he may desire.

A reproduction of the collotypic grain is now made in the camera upon glass in the ordinary way. If enlarged to four diameters, the grain is shown to be in the shape of vermicular markings (see fig.). In this coarser condition



the "grain" is transferred by the photo-lithographic process to stone, from which prints upon paper can be pulled. These prints exhibit a coarse vermicular grain; and then the intervals between the little serpentine lines are filled up by hand with fine black dots, as shown in one-half of our sketch.

The grain, thus perfected, may be considered a "pattern grain," and serves for all sorts of photo-block printing. By means of the camera, a series of reproductions of the "pattern grain" are taken, some on a large scale, and some on a small scale, and these negatives serve for general work. According as it is a large or small printing-block to be produced, so a fine or coarse "pattern grain" negative is used, the grain negatives being stripped from the glass and preserved in the form of films. The stripping is done as usual either by employing castor oil collodion, or gelatine to which a little glycerine has been added. Once in possession of a series of "pattern grain" films, the preliminary difficulty is overcome.

To produce a grained photo lithograph or photo zincograph, the grain film is put between the negative and the prepared sensitive paper, and the latter is then printed and treated in the ordinary way. But in fine photo-printing blocks this plan will not answer by reason of the unsharpness that results from the negative not being in absolute contact with the prepared paper; Herrn Marriot and Sommer, therefore, in this case place the grain film (a dispositive) in the camera upon the plate, and thus produce a single cliché with image and grain combined, which prints quite sharp.

A process which Herrn Marriot and Sommer term a "Universal Printing Method" has also been elaborated by these gentlemen, by which photo printing blocks are produced by etching upon copper or zinc from positive clichés, whether these are of half-tone or black and white subjects. A dispositive "pattern grain" is printed upon ordinary photo lithographic transfer paper, and inked up with the velvet roller, transfer ink or etching preservative being employed. The impression is then transferred to zinc. This, when etched for a typographical printing block, would

give a negative impression. By adopting the following process, however, a positive print can be secured. The zinc, protected with etching preservative, is covered with a solution of shellac, viz.:

Brown shellac..... 7 parts.
Alcohol..... 160 "
Ether (colored with a few drops fuchsine)..... 40 "

The shellac solution, when applied, attaches itself only to the bare metal. Where the asphalt and turpentine mixture is, the alcoholic solution of shellac is repelled, and forms itself in tiny drops. The zinc plate is dried, and then treated with spirits of turpentine or rectified oil of turpentine. This dissolves the asphalt (penetrating the shellac film), and only leaves a shellac film where the shellac is close against the zinc. In this way the picture on the zinc is reversed. The plate may now be etched with dilute nitric acid as usual, and we may add that the method is one that is applicable to zinc, copper, or stone.

A modification of the "Universal Printing Method" for zinc typographical blocks consists in placing, as above, a transfer upon zinc, produced as we have shown, from a "pattern grain" dispositive, and then reversing the impression upon the zinc plate, so that it furnishes positive prints. In this case, the following method may be substituted for the one we have just mentioned.

The zinc plate, with its impression, is faced with copper in a cyano copper bath, having recourse to a weak galvanic current.* Afterward, the fatty transfer image is removed with spirits of turpentine, when only the copper image remains upon the plate. Treated with dilute sulphuric acid, the plate is etched, where bare zinc is visible, but remains sound where faced with copper; still, the process is rather more complicated than that in which the shellac solution is employed.

As to the practicability of the processes of Herrn Marriot and Sommer, it may be mentioned that at the last meeting of the Vienna Photographic Society some excellent prints were exhibited by those gentlemen, which attracted considerable attention.—*Photo. News.*

[BRITISH JOURNAL OF PHOTOGRAPHY.]

MOUNTING PRINTS WITHOUT PRODUCING DISTORTION.

Most photographers are now fully aware that a photograph when wet is larger than when it is dry. This is owing to a property which paper, like many other materials, has of expanding when subjected to moisture. It is also tolerably well-known that the expansion is not equal in all directions, as paper, like wood, expands more in one direction than it does in another. A deal board, when wetted, expands considerably in its width, though its length is but little affected. So it is with paper when made in continuous lengths, as all photographic papers are.

This property frequently gives rise to considerable trouble in mounting photographs—particularly when two or more prints have to be joined, as is occasionally the case with large pictures when they have been printed from two or more negatives. Serious inconvenience may also arise through this unequal expansion of the paper in small portraits, by causing a distortion of the features, as we explained in a leading article in a recent volume. Two prints made from the same portrait negative, on paper which had been cut in different directions from the sheet, possessed a palpable difference in the length and breadth of the features when they were mounted wet.

We have previously detailed a series of experiments made with different samples of machine made papers. These papers are made in continuous lengths, and are cut up into sheets afterward. In these experiments it was found with nearly all samples that, when strips were cut lengthwise from the roll, the expansion, when they were soaked in water, was exceedingly small, but when cut transversely the expansion was very great; and what is of material importance in mounting photographs, it was found that strips so cut could be stretched considerably more. For example—a strip of Bax paper, twenty-four inches long, cut transversely from the roll, by being mounted wet and gently stretched while mounting could be made to measure fully twenty-five inches, and with care, we doubt not, it could be made considerably longer. If the paper be allowed to dry after being wetted and expanded, it will contract again, but not quite to its original dimensions, though it does very nearly. Hence, if prints are required of the size of the original negative, as we then explained, they should be dried before mounting, and then wetted as little as possible in the operation. A solution of gelatine containing a large proportion of alcohol was recommended for the purpose. With a view to avoid the distortion sometimes existing in carte or cabinet-sized prints, when they are mounted wet and are liable to be stretched somewhat by the mounter, we advocated the same system and mountant to be employed.

At a recent meeting of the Photographic Club one of the topics of discussion was on the subject of "Mounting-Photographs," and Mr. A. Cowan showed a method he had employed for carte and cabinets with great success for several years past. By this system the distortion caused by the expansion of the paper, which at times becomes a serious inconvenience, is practically avoided. The method also possesses many other advantages—simplicity and cleanliness not being the least. Although the principle of cementing the print and allowing it to become dry before mounting is not new, yet the method described at the Club differs somewhat from those hitherto published; we therefore give it for the benefit of our readers as communicated to us, as, in consequence of a temporary absence from town, we were unable to be present at the meeting of the Club.

The prints, after they are taken from the washing water, are laid face downward on a plate of glass—not in a neat pile, as usual when mounting is done wet, but just as they are collected in the tank. The glass, with the adhering print, is then reared on end to allow the superfluous water to drain away. When the prints have drained for a short time they are brushed over with starch paste in the ordinary manner. Each print as it is starched is lifted from the glass (by raising one corner with the point of a knife), and laid out to dry. The drying arrangement is deserving of notice, as being exceedingly convenient when large numbers have to be dealt with, or space is somewhat circumscribed.

Mr. Cowan has a number of wooden frames covered with canvas. In each corner is a screw projecting about a couple of inches or so. When one of the frames is covered with the starched prints, another frame is placed upon it—the

* The cyano copper bath should have very little or no excess of cyanide of potassium, or the zinc will be eaten away. The galvanic battery should consist of four zinc-iron elements, standing in dilute sulphuric acid. See's battery is too strong.

* The etching preservative consists of asphalt, turpentine, etc.

projecting screws preserving a space of a couple of inches between the two. When the second frame is filled, a third is put into position, and so on with any number of frames, that may be required. The prints dry quickly on these frames, are preserved from dust while drying, and the whole arrangement occupies but little space. The starched print also dry without curling up, which is a great convenience in the after manipulations. After the prints become dry they are trimmed, and are then ready for mounting at once, or they may be kept for any length of time without deterioration. Some of the prints used in the demonstration had actually been starched for several years.

The method of mounting is exceedingly simple. A pile of cards is placed on the table, and the top one is then slightly dampened with a clean sponge moistened with water. This card is now drawn slightly forward on the pack, and the print is then adjusted in position upon it. This is easily done, as the dry, starched surface has no tendency to stick to the card, as it would have if it were wet. When the print is placed in position, it is held there by a couple of fingers of the left hand, while the thumb and two fingers (slightly separated) of the right hand firmly grasp the bottom of the card together with the print. In order to prevent the print being misplaced, the thumb is pressed firmly enough to bend the card between the fingers considerably. All that now remains is to pass the print and card between the rollers of an ordinary rolling press, when the print will be found to adhere with great tenacity. Indeed, so firmly adherent is the print after having passed through the press, that it was found impossible to separate it from the card without tearing, although the experiment was tried immediately afterward. Hence, the necessity for holding the print and card firmly until they are gripped by the rollers will be apparent. So exceedingly expeditious is the process, that many dozens of prints could have been mounted within the time it has taken to write this brief description. It would be superfluous to enumerate all the advantages of this system of mounting, as they will be obvious to every reader.

Although only carte and cabinet sizes are mentioned, it is manifest that the same principle of mounting can be applied to pictures of larger dimensions. It may be as well to mention that in the press used in the demonstration the rollers were nickel-plated, to avoid their becoming rusted by continued contact with the slightly moistened cards.

GILDING BY SIMPLE IMMERSION.

A SOLUTION suited for cheap gilding, and applicable to large surfaces generally, is made as follows: Dissolve 2½ pounds of caustic potash, 5 ounces of pearl ash (carbonate of potassium), and 3 ounces of cyanide of potassium in 5 quarts of water, in which must have been previously dissolved ¼ ounce of gold chloride. Before using, this solution must be heated nearly to boiling, and it is upon the temperature that the color will depend. It is suited for the gilding of clocks, bronze figures, and gas-fittings. It may be necessary to work up the surface obtained with a brush and whiting, finishing with rouge and burnisher.

Another solution, the particulars of which are due M. Roseleur, is composed of pyrophosphate of soda 800 parts in 10,000 parts of water, adding eight parts of strong hydrocyanic acid. Convert ten parts by weight of gold into dry soluble chloride, dissolve it in a reserved portion of the water to which nothing has been added, and mix both solutions together, cold. When cold the solution is yellowish, but becomes dark upon heating. It is used hot. Poor cyanide, or hydrocyanic acid, will make it appear red, and more must be added until the color disappears.

It is necessary to "quick" all the goods to be gilded in this solution, in nitrate of mercury solution, in the usual way. Motion must be given to the articles while being gilded. It is recommended to gild first in a nearly exhausted solution of the same kind, to lay a preparatory skin; then a slightly richer solution, and to finish in a freshly prepared one to give a good color. A few seconds in each solution are sufficient. If it is desired to lay "green" or "white" gold, add to the last solution a solution of nitrate of mercury, drop by drop, with stirring, until the desired color is apparent.

It is not uncommon in factories to do a great deal of the gilding by the simple-immersion process alone. It is possible to do this by very often "quicking" the surface in the mercury solution. First the cleaned article is "quicked," then rapidly gilded, "quicked" again and gilded, and so on for five or six dips. The work may be got through more rapidly than might be expected.

A very good solution for simple immersion is made by dissolving one part of gold chloride in water, and adding to it, gradually, thirty-one parts of acid carbonate of potassium. Then mix the solution with one composed of thirty parts of acid carbonate of potassium in 200 parts of water. The whole must be boiled for two hours. As soon as the solution turns green, it is ready for use. It is not necessary to "quick" the surfaces of articles to be gilded in this solution, but it is advisable to do so for the best work. To gild German silver or silver, they must be dipped with zinc strips or wires attached loosely to them.

Silver articles are perfectly gilded by the following solution, applied hot: Dissolve an ounce each of sal-ammoniac and corrosive sublimate in three ounces of nitric acid; add some grain gold to it and boil down to half its bulk.

To gild in different colors, various methods are in use. Thus, we employ any of the solutions given, and obtain a red gold when the temperature is high. If a green gold is required, the articles are immersed at a lower temperature, and a solution of silver nitrate added drop by drop, with stirring. It is found that a very little silver in a gilding liquid will turn the deposit green and white, while a very little copper will turn it red.

To gild "dead," make up a mixture of sulphuric acid, 2 ounces; nitric acid, 2 ounces; common salt, ½ ounce, and dip the jewelry into it for a moment only, or until it presents a dead appearance—then gild in the usual way.

To "bright gild" a specific article, a brass watch chain, for instance, commence by pouring hot water into a vessel over the chain, and into this scrape a quantity of bath-brick and soap. Rub the chain briskly in the hands for a few minutes to clean it. Next, substitute whiting for the bath-brick, and rub in the hands with soap and water until all the links are smooth. This done, wash well in hot water to remove the soap, and when clean fasten a slender wire to the article and dip in the gilding bath. The result is, perhaps, a fairly good color at first, which may remain until we think the chain is well coated. But, as a general rule, the chain is no sooner in the liquid than it begins to change color to a dirty and apparently unsatisfactory yellow, which then deepens to brown, after which, as a rule, no more gold will go on. This bad color must be worked off by rubbing in the hands with whiting and soapy water, when a fine rich

yellow appears; and as soon as this is well exposed in all parts, wash off the soap. Dry the chain in sawdust, and then bring up its surface by rubbing briskly in the hands with dry sawdust. A shake will finish the process. These simple directions will enable amateurs to do such work for themselves, and any of the good solutions may be employed. Articles of jewelry which cannot be cleaned in this way should be rubbed with a brush.—Watchmaker.

A NEW MERCURY DISTILLER.

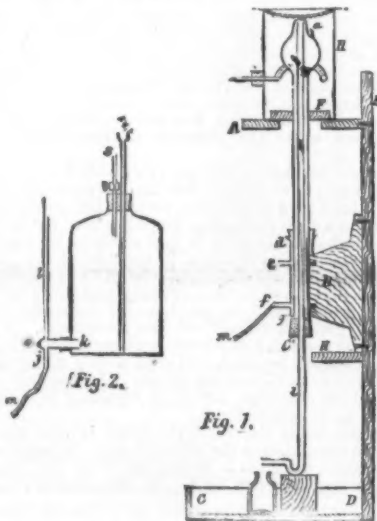
MERCURY is now so largely used, not only in the laboratory but for industrial purposes, such as ore reduction, electric engineering, and so on, that a quick and efficient means of purifying it is a valuable acquisition. The apparatus for this purpose, which we are about to describe, has been devised by Mr. J. W. Clark, Demonstrator of Physics in University College, Liverpool, and was recently brought before the Physical Society of London.

The usual processes for purifying mercury are either chemical, such as treatment with dilute sulphuric acid, etc., or mechanical, such as shaking and filtering through wash-leather, or distillation, either *in vacuo* or under the ordinary atmospheric pressure. Of all these methods the best is distillation *in vacuo*.

Prior to distillation it is well to filter the mercury through a cone of writing paper with a very small orifice at the apex, and to remove the lead or zinc present by chemical means; for the rate of distillation is lowered by these impurities. The presence of 0.0001 part of lead is said by Herr Gmelin-Krantz to reduce the quantity of mercury distilled in a given time from 67 to 5. Gold, iridium, copper, tin, nickel, cadmium, and arsenic do not influence the rate of distillation.

The distillation of mercury at ordinary pressure is an inconvenient process. The first apparatus for distilling *in vacuo* was probably devised by Weinhold, and others have been designed since by Weber, Shaw, Wright, and others. The arrangement of Mr. Clark, however, differs from all these in the important respect of dispensing with an auxiliary Sprengel air pump, and in, so to speak, acting as its own air pump. This is effected by supplying the mercury to be distilled from a movable reservoir in the form of a constant level regulator. On raising this reservoir, which is illustrated in Fig. 2, the mercury is supplied to the stiller.

The stiller is shown in section in Fig. 1, and consists of a lead glass tube, *ab*, 36 inches long, and about ¾ inch in-



ternal diameter. About 2 inches from its closed upper end is blown a bulb about 2 inches in diameter. The lower end passes through an air-tight cork of rubber, closing the top of the cistern, *d c*, and ends at *b*, a little below the tube, *f*. The cistern, *d c*, is made of glass tube 1 inch in diameter and 12 inches long, and has two short pieces of "quill" tubing, *e f*, sealed into it. The lower end is also closed by a cork through which passes a piece of Sprengel tube, *i*, 36 inches long, and having a piece of quill tubing, *A*, about 24 inches long sealed into the upper end. The top of this tube is nearly in contact with *a*. The internal diameter of the Sprengel tube should not much exceed one millimeter, and the bend of the lower end is best when not much more than 1 inch in radius.

The base of the stand is a wooden tray, *C D*, from which rises a board, *D E*, carrying a shelf, *A E*, perforated in the center with a hole allowing the glass bulb to pass through it. A large cork, *F*, is bored with a hole of rather less diameter than the tube, *a b*, and the cork is cut in halves. The tube is held in position by twisting a piece of copper wire round the halves of the cork. The cistern is secured by string passing through holes in the projecting piece of wood, *B*. A block of wood serves to support the end of the tube, *i*, and a tin cylinder notched round the top, and covered with a flat tin plate, keeps the bulb surrounded with hot air, while a mica window at the side allows the height of the mercury in the bulb to be easily seen. The pipe of the brass ring burner passes through a hole in the tin gas plate, and the ring, slightly larger than the bulb, is perforated on its inside with many holes.

The constant level reservoir is a large glass bottle provided with a tubulure at the side. Similar bottles are now made for the mercury pumps of electric incandescence lamp manufacturers. Into the tubulure passes a glass tube, *k*, about 3 inches long and ¼ inch in diameter. Its outer end is closed, and into the upper and under sides are sealed two pieces of quill tubing, *l* and *j*. The top of the upper end is open, but the lower, *j*, is connected with the cistern of the stiller by a narrow piece of India-rubber tubing, *m m*, about 3½ feet long inclosed in a canvas tube. The "thistle" funnel, *l*, and small glass stop-cock, *S*, shown are also fitted air tight into the bottle by an India-rubber tube. The reservoir is placed on an adjustable table stand on the shelf, *H*, (Fig. 1).

To set the stiller in action, the stop-cock, *S*, of the reservoir is opened, and some mercury is poured through the thistle funnel, *l*, into the reservoir, while with a short piece of India-rubber tubing and glass rod the tube, *a*, is closed securely (Fig. 1) at the top by the cistern. Then the reservoir is raised. The mercury gradually rises in the cistern, and by compressing the air in the upper part is forced up

the tube, *a b*, and then, filling the bulb "sprengels" down the tube, *M*. The reservoir may then be lowered to its stand on *H*, and the India-rubber stopper removed from the tube, *a*. The reservoir is set in action by attaching a piece of rubber tube to the stop-cock, *S*, and sucking out air until passing down the tube, *l*, it bubbles up through the mercury in the reservoir. Then the stop-cock is closed, and the reservoir adjusted at such a height in the stand that the mercury is nearly at the top of the bulb in the stiller. Thus set in action, the level of the mercury in the cistern, *c d*, will be kept constant until almost all the mercury has been distilled.

To start the distillation, the tin plate which covers the cylinder, *H*, is removed, and the gas lighted. A few minutes later sufficient mercury will have distilled over to displace the impure mercury originally present in the narrow Sprengel tube, *i*.

The reservoir is replenished with mercury without interrupting the distillation by placing a screw pinch cock on the rubber tube leading to the cistern of the stiller, opening the cock, *S*, and pouring the mercury into the reservoir through the funnel, *l*. Then a few bubbles of air are sucked out of the reservoir as already described, the stop-cock is closed, and the screw clamp released from the India-rubber tube. The level of the mercury in the stiller remains as before.

Such an apparatus as that illustrated will distill about 2 lb. of mercury per hour with an expenditure of very little gas. Zinc, cadmium, magnesium, and other metals may also be distilled by the same plan.

AN EARTHENWARE TEA CUP.

ONLY an earthenware tea cup! And yet, to manufacture a cup similar to this cup, simple as it seems, we shall require a plastic clay body composed of 20 parts ball clay slip, 16 parts china clay slip, 9 parts flint, 4 parts stone, and 4 parts stain, 28 ozs. to pint. To make this body stain, we shall require 15 lb. prepared oxide of cobalt, 15 lb. prepared flint, and 2½ lb. red lead.

To make the several slips, each clay is placed separately into its own vat, or ark, as the vessel is called, and there blended, or plunged in water, until the clay and water form a batter about the consistency of cream. The flint is first burnt in a kiln to calcine it, then ground into a powder in a flint mill. The stone, too, is ground to a powder. The slips are now sieved through fine silk lawns, and the powdered flint and stone carefully sifted into water; then all these slips are mixed together in one common ark. The next step is to pump the mixed clay through a wooden trough containing a number of magnets, into the clay press. The magnets are used to remove all trace of iron from the slip. Should any iron be left in the slip, the ware would be discolored with brown specks. The clay press removes all excess of water, and reduces the slip to clay. It is now ready for pugging in the pugging mill.

The old method was to pump the slip on to a slip kiln, and evaporate the water by heat, until the clay was of a proper consistency for wedging or pugging.

The clay press does away with the slip kiln, and the pugging mill does away with wedging. Wedging at one time was done exclusively by hand, so the new method must have the advantage of time saving over the old method—the question of time being always a matter of considerable importance to a manufacturer anxious to get his goods into the market.

Having prepared our clay, the next business is to decide whether or not we shall press our tea cup, or throw and turn it.

Upon a close examination of the pattern we find that it has been thrown and turned, so we cannot do better than throw and turn ours. For the purpose of throwing our cup, we shall have to adjourn to the throwing shop. And here we become acquainted with the duties of the baller and thrower.

The baller is usually a woman, and it is her duty to cut, weigh, and mould the prepared clay into balls, the size required for the article about to be thrown.

The thrower is seated at his wheel, or lathe, which is fitted into the center of a shallow, water-tight, box-like table or bench, the wheel being elevated a little above the surface of the bench, and this wheel is worked underneath the bench by means of a leather strap on a vertical spindle. The motive power used to be supplied by a workwoman, called in the trade a wheel turner, but steam has now taken the wheel turner's place in almost all the large manufactories.

The baller's bench adjoins the thrower's, in the front of which she stands while following her employment. When the baller has moulded a ball of clay, she tosses it to the thrower.

The thrower having arranged the pegs in his gauge to suit the size of the cup he is about to make, receives the ball of clay from the baller, dips it into the water contained in his bench, then expertly throwing it on to the center of his revolving wheel, he draws the clay up into the shape of a cone, then he depresses it, and draws it up again. He repeats this until he is assured that no air bubbles remain in the clay. He next manipulates the clay with his fingers and thumbs alone, dipping them into water from time to time, until he has formed a rude cup; then with the assistance of a tool, made of earthenware or slate, called a profile, or rib, he quickly shapes the inside of the cup, and removes all slurry. The cup being thrown, the thrower cuts it from the wheel with a thin brass wire that has small wooden handles at each end, and then, placing it upon a board six feet long, it is taken with others into the stove room to dry.

When partially dry, the clay cup is said to be in the green state; when in this state, it is considered to be in the most favorable condition for turning and handling.

Now as our cup must be turned before it can be handled, we shall have to pass on with it from the stove room to the turning shop, and here we are introduced to the turner and the process of turning.

The potter's turning lathe is of similar construction to that of the wood turner's. It has a screw thread at the end of its spindle, and upon this screw thread the turner screws his wooden chucks; these chucks are tapering in form, and are varied in size to suit the size of the article about to be turned. The tools used by the turner are made of iron, and are about six inches in length, varying in width from a quarter of an inch to two inches. The cutting ends of these tools are finely ground, and turned up about a quarter of an inch. Besides these cutting tools he has another, called a polisher, or burnisher; this last is made of steel.

Many of the potter's lathes are now turned by steam power, where there is steam employed upon the factory; others again, are turned by women; these women are known in the trade as lathe treaders, and it is needless to say that

they follow their calling in the same shop with the turner. The turner, having by this time fixed the cup he is about to turn upon the wooden chuck, the lathe is set in motion, and he proceeds to form the foot of the cup with one of the iron tools mentioned above. He next removes, by cutting or scraping, all little inequalities there may be upon the outer surface, after which he polishes it with the steel polisher, or burnisher; this he applies with a steady, gentle pressure, until there is a uniform smoothness of surface. The cup is now ready for the handler.

The handling department in the potting trade is a complete branch in itself, the handlers serving a full apprenticeship to their calling. The business of handling is followed both by men and women.

For the making of ornamental handles, the handler uses plaster of Paris moulds; these moulds are generally in two halves, the one half acting as a cover to the other. The form, or die, of the handle to be made is sunk in the center of the mould, into which the clay is pressed.

Plain handles are made with a small machine, a kind of syringe worked by a screw; the cylinder of the syringe is first filled with the clay, then the piston is inserted, and the screw turned. The turning of the screw presses the piston down on the clay; this forces the clay through an opening at the bottom of the syringe, in the shape of long strings; these strings of clay are then cut into the requisite lengths required for the handles, and bent to the necessary form. The handles are now placed in the hot-house or sunshine to harden a little; after hardening, they are united to the cups with slip clay, and all inequalities trimmed away with a small knife, the jointure being smoothed with a camel's hair brush. These little touches are known in the trade as *fettling*. This completes the cup in the clay state, and makes it ready for baking or firing in the biscuit oven; when fired, it is ready for embellishing in the biscuit and for glazing.

Having thrown, turned, and handled our tea cup, we will now proceed to fire it. This first firing that the clay ware is subjected to is known in the trade as *biscuit firing*; the man who fires the oven, as *biscuit fireman*; and the men who place the clay ware into the seggars, as *biscuit placers*. The placers have a workshop to themselves, and work at a bench.

The seggars used for firing cups in, are in the form of an oval shaped, rough earthenware box, the bottom of which is covered with a layer of sand. Upon this layer of sand a layer of cups are placed, spaces being left between the cups to prevent sticking. The cups are now filled about half full with sand, and another layer placed with handles reversed; this is repeated until the seggar is full. When full, the spaces left between the cups are filled up with sand, and the edge of the seggar sanded.

The seggars of cups are now ready for firing, and are carried upon the head of the placer to the oven, where they are placed in piles, fourteen or fifteen seggars high, each seggar acting as a cover to the one below.

A pile of seggars is called by the placer a *bung*. When the oven is filled with these bungs of seggars, the clammings are put up, and the oven fired. The clammings consist of fire bricks and knockings of marl, the fire bricks being used to close up the mouth of the oven, and the knockings of marl to plaster over the crevices so as to exclude the air. The oven is pierced by eight smaller orifices besides the mouth; these small openings are called *trial holes*, and are arranged four at the bottom and four toward the top. Each of these small holes has a direct communication with a seggar containing the trials by which the oven is fired. These trials are composed of the same body as the cups, and they are made in the form of a small ring. The trials are made in this form for the convenience of the fireman, who must draw his trials from time to time to ascertain if the heat of the oven is getting up, and to judge by their appearance as to when the ware is fired enough.

The time taken to fire up a biscuit oven is somewhere about forty-eight hours; when fired, the clammings are knocked down, and the oven left to cool for another forty-eight hours. It is then ready for drawing.

The drawing of the oven is done by the biscuit placers, who station themselves in the oven one above the other, and the one who stands highest is said to be drawing tops. It is his business to lift the top seggars and hand them down to the man stationed below him, he to the next, and so on. When drawing what is known as a hot oven, the heat is often overpowering, and the man engaged in drawing tops soon becoming exhausted, another takes his place; and so they work change and change until the oven is drawn.

The ware from this oven is taken into the biscuit warehouse and given in charge to the biscuit warehouseman, whose duties consist in counting the ware as it comes from the oven, overlooking the workwomen engaged in the warehouse, giving out work to the different branches of biscuit decorators, and stock-taking.

The work of the women who are employed in the warehouse consists in looking over, brushing, scouring, and stopping. In looking over, the cups without blemish are selected for first-class goods. Those with small flaws are set aside for seconds goods, and after the seconds have been taken away the remaining ware is subjected to another scrutiny, and thirds are picked out. What is left, such as the badly cracked, fire-cracked, and discolored, is known as hump ware. Only those cups which are utterly useless find their way to the shord-ruck. The sand used in the placing of the ware will adhere to it sometimes; when such is the case, and the sand cannot be removed by brushing, sand-paper has to be resorted to, and the ware is scoured. Some of the cups among the seconds and thirds will have small fire cracks in them, or the handles will be drawn away from the cups a trifle; when this is so, the little imperfections are repaired with a material called *stopping*. This stopping is applied to the ware in a semi-liquid state with a camel's hair pencil. Should any unevenness of surface appear as the stopping dries, it is smoothed away with the wooden end of the pencil.

As some of the ware is ornamented while yet in the biscuit state, so some again is left until glazed before ornamentation. Our cup being one among the latter, we pass on with it to the dipping house. The dipper informs us that for a body similar to the body of which our cup is made, there will be required a glaze, the component parts of which will be something like the following: 145 parts tincal of borax, 120 flint, 30 stone, 15 china clay, 30 whiting, and 10 soda. Frit mixture for above glaze: 155 frit, 118 stone, 40 whiting, 15 flint, and 35 lead. The dipper upon further inquiry tells us that easy fired ware does not take so thick a glaze as hard-fired ware; the former being so much the more porous than the latter absorbs the glaze the more readily, consequently the glaze must be mixed thinner. When the dipper desires to know if the glaze is of the right consistence for the ware he is going to dip, he takes a piece, dips it, and

places it aside to dry; when dry a slight scratch to the surface of the ware informs his experienced eye when it is of the proper thickness. Glazes vary a great deal, but in all cases the glaze should scratch up thicker upon hard-fired than it should upon easy-fired ware. Again, if the glaze is too thick, it will run when fired in the glost oven. If the ware has been painted or printed before dipping, and the glaze be too thick for the color, the high heat required for the glaze will cause the color to flow. All these little niceties are of the first importance, and can only be learned by long practice and quick observation. Dipping in itself seems to be rather a simple matter. The article to be dipped is balanced on its edge upon the tips of the fingers (for some articles hooks are used), dipped into the glaze contained in the dipping tub, a quick twist is given to it as it emerges from the tub to enable it to throw off the superfluous glaze, and presto! our cup is now ready for the glost oven. But before it can be fired, it will again have to pass through the hands of the placers.

CHAMPAGNE MAKING IN FRANCE.

IN the champagne district the greatest attention, says Consul Frisbie, is paid to the picking of the grapes, the fruit being supported in the left hand so as to prevent the riper grapes from falling, and care being taken not to bruise the fruit in throwing it into the baskets. These baskets, when full, are emptied into larger ones, and minutely examined, in order that all the bruised, rotten, and unripe grapes may be removed. If the grapes are very ripe, wisps of straw are placed in the bottoms of the baskets to prevent jolting and bruising. The picking usually commences with daylight, and the vintagers assert that the grapes gathered at sunrise always produce the best wine, and that by plucking the grapes when the early morning sun is upon them they are believed to yield much more juice; later in the day, in spite of all precaution, it is impossible to prevent some of the detached grapes from partially fermenting, and this frequently has the effect of imparting a slight excess of color to the must.

The gatherings of one day are pressed the following morning, the operation being effected by means of presses of different kinds, the most ancient being the *cliquet*, which is largely used at the present day. It is worked by a roller and grinders—large pieces of wood which are placed in layers on the pressed grapes. The grapes are spread over the floor of the press in a compact mass, only the first pressure producing a high class wine. Before beginning to press, the grapes are weighed, and 400 kilogrammes are allowed for every 40 gallons of wine, and this having been obtained, no more is pressed from it for first-class wine. The remainder then consists only of a heap of crushed fruit. The edges of this heap are next cut off in various ways according to the shape of the press, the edges having been subjected to less pressure than the middle. The grapes thus obtained are then subjected to a second pressure, which produces a juice called *first taille*, and this operation is repeated to get a second *taille*, and a third time for the last juice, called *recoche*, a production which, in the champagne country, is only used for the consumption of the laborers, as is also the case with the produce of the second *taille*.

When the wine is flowing from the press, the juice is tested with a wine tester or glycometer, to ascertain its sweetness and the amount of sugar it contains. Then, when the wine is drawn off from the press, it is put into tubs or casks, and is left until the impurities thrown off have collected on the surface in the shape of a scum, called *cotte*. As soon as this scum rises to the surface, the casks are filled and vaporized by burning sulphur. This operation, setting free sulphurous acid, tends to whiten the wine and prevent the taste of oak from flavoring it.

The casks are then placed in the cellar on supports, usually about 8 inches above the ground, care being taken not to fill them quite full, as, when fermentation begins, they would overflow. A margin of several quarts is therefore left, and the bung is closed with vine leaves and a small tile. After a month has elapsed, and the fermentation subsided, the wine is racked off into other casks by means of copper basins and vessels. With the approach of December comes the frost, which makes the wine quite clear; it is at this period that the mixing is performed, an operation which immediately precedes the blending. The mixing consists of bringing together thirty or forty casks of the same growth. The blending, on the other hand, is the mingling of all these wines, with a view to the formation of a large quantity of wine for commercial purposes. It is at the blending time that the tannin is used, in liquid or powder, to anticipate various defects in the wine, such as grasse and deposits. These deposits are known in the wine district by the technical names of *marques*, *barnes*, *cule de poule*, and *lentilles*. It is at this time also that alcohol, in greater or less proportions, is added. The wine merchants find the degree of alcohol by distilling a given quantity of wine, of which they take a third, and mix the result of the distillation with some distilled water, weighing with an alcoholometer, and taking into consideration the degree of temperature. Champagne wines generally have from 11 to 12 per cent. of alcohol; but in some very good years, such as 1865 and 1874, as much as 14 per cent. If the year should be a poor one, and the degree of alcohol insufficient, it is remedied by adding a sufficient quantity of spirits of 88°, made from the best Cognac brandies.

The day after these operations have been completed, the fining is commenced, and this is done with isinglass, prepared beforehand with a slight admixture of tartaric acid. Every cask of white wine receives a slight proportion of this mixture, and is stirred with a stick before and after mixture, this being done with the object of thoroughly mixing the wine and isinglass. The casks are then hermetically sealed, a small hole being drilled in the top of the cask, and closed with three straws of rye or wheat, with the heads on; this admits sufficient air to remove all danger in case of fermentation. The wine remains in this state for about a fortnight or three weeks.

When the wine is ready for bottling, the operation is effected by means of taps with six, eight, or ten spouts. The bottles when filled pass into the hands of the corker—the corking being done with a mallet, and the cork secured. The bottles are then stored in the wine vaults, or left in the cellars, where they are stacked with rods and laths.

In the month of July, when the bottling is over, the workmen find employment in removing defective hoops, or replacing them by new ones, and this operation, with the vintage, continues till the time of early frost. At this time many vineyard proprietors bring what they have bottled up again to the upper cellar, as the cold has the effect of helping the deposits to dry. Others simply change the position of the bottles, removing the leaky and broken ones, and making new piles. It is at this time also that attention is

paid to the *maquis*, the name given to the deposit on the side of the bottle, and which must be removed. This is done by means of a machine, which consists of a box into which are placed two bottles having the deposit in them; by means of a handle a rotary motion is imparted to the bottles, which are further subjected to continued blows from two little hammers. These continued shocks produce a shaking, which is sufficient to detach the adhesive deposit. The removal, by hand, requires more attention. The workman is supplied with an iron implement, and has to be careful to hit the bottles just hard enough to detach the crust. When the bottles are entirely cleared of deposit, they are placed neck downward, either on tables or on racks, and after being kept for some time in this position, the wine is shaken to make all the deposit fall on the cork. This is an important operation, and great care is taken in the selection of workmen to perform it. It is effected by very slightly lifting the bottles, and gently shaking them in that position. To bring it to a successful issue requires a month or six weeks, or even more, the bottle being moved every day. When the deposit has altogether settled on the corks, the good bottles are placed in stacks, with their necks downward, at a sharp angle, to await the time when they are again uncorked. The rest are replaced and worked a second time on the rack. The uncorking is also a difficult and delicate operation. It is necessary to remove the cork and wiring with the least possible loss of time, the bottle being all the time kept neck downward. To do this, the workman watches the bubble of air which is in the bottle, and so removes the cork that only the deposit is ejected by the rush of gas. When the froth appears he uses part of it to wash the neck of the bottle, and then inserts a small cork prepared for the purpose, which prevents too great a loss of gas. The bottle then passes into the hands of a man who takes out enough wine to admit the necessary amount of sirup.

The wine is now very dry, and would not be drinkable; this dryness is, however, corrected by the addition of what is called the "export sirup," which differs from what is put in at the time of bottling. It is composed of 150 kilogrammes of candied sugar to every 100 liters of wine, and 3 quarts of alcohol added to increase the strength. As the sugar dissolves the wine becomes thick, and must be filtered to make the liquid perfectly clear.

The bottles when opened and emptied to a certain depth, are taken to the "mixer." The mixing consists in putting into each a certain equal quantity of sirup, the precise proportion differing for each country; the bottle is then placed on a revolving table, and, as it revolves, all the bottles in turn come to the corker. The second and final corking requires more care than the first. The corks used are made from Spanish cork, soft or strong, hard and full, or red corks, according to the country to which the wine is intended to be sent. They are soaked for a few days in cold water before being used. For the final corking the machine used is often a mallet machine, but others are employed. The cork is put into a tube, pressed, and made to come level with the lower end of the tube, and with a clean sponge the few drops of water which have resulted from the compression of the cork are wiped off, and the bottle is then filled and corked, the cork being driven in to a greater or less extent according to the destination of the wine. The tying up is then proceeded with, oiled string being used. After the string is put on the wire is attached, the kind most in use being galvanized wire. It is at this time that the bottle is shaken once or twice, to mix the sirup thoroughly with the wine. Then the bottles are arranged in piles, always on end, and are left for a month or two.

In conclusion, Consul Frisbie states that to make a good bottle of champagne at least two years of constant work and care are necessary.

A MEANS OF SEPARATING HEAT RAYS FROM LIGHT AND CHEMICAL RAYS.

FUSE a drop of distilled selenium, place it upon a plate of glass, and cover it immediately with another thin plate of glass. Compress the drop, by means of a small rod, so that it spreads evenly into a very thin film between the two plates. This operation is performed upon a metal plate kept at a temperature of 250° C., after which the plates are allowed to cool slowly under pressure.

Care must be taken to prevent the selenium from boiling and thus forming bubbles, which would allow day light to pass through without decomposition. If the operation be successful, the chemical rays will be reflected while the visible rays will be absorbed and converted into electrical energy; the heat rays only will pass through, undergoing thereby a peculiar refraction which has not yet been explained.

A very thin film of selenium allows the passage of monochromatic red light, the faintly luminous spectrum of which extends from A to C, but never reaches D. With a thicker film of selenium no visible light passes through.

Tyndall, in 1863 employed a solution of iodine in bisulphide of carbon, which absorbed all the visible rays, while it permitted the passage of the ultra-red heat rays with very little diminution.—*Compt. Rend.*

MAKING TINCTURES.

MR. ALFRED B. TAYLOR says: For some years past I have employed a process for making some of the fluid extracts, tinctures, etc., of the Pharmacopœia, which has proved very satisfactory.

I have found it especially serviceable in making those preparations which are made from drugs that are difficult to exhaust with small quantities of menstruum.

The process consists in using a portion of the finished preparation (from a previous operation) to macerate and partially exhaust the drug before using the new portion of menstruum; and as there is no limit to the quantity of finished preparation that can be used where necessary, it is possible to exhaust completely the drug operated on.

For example, let it be required to make two pints of tincture of arnica flowers:

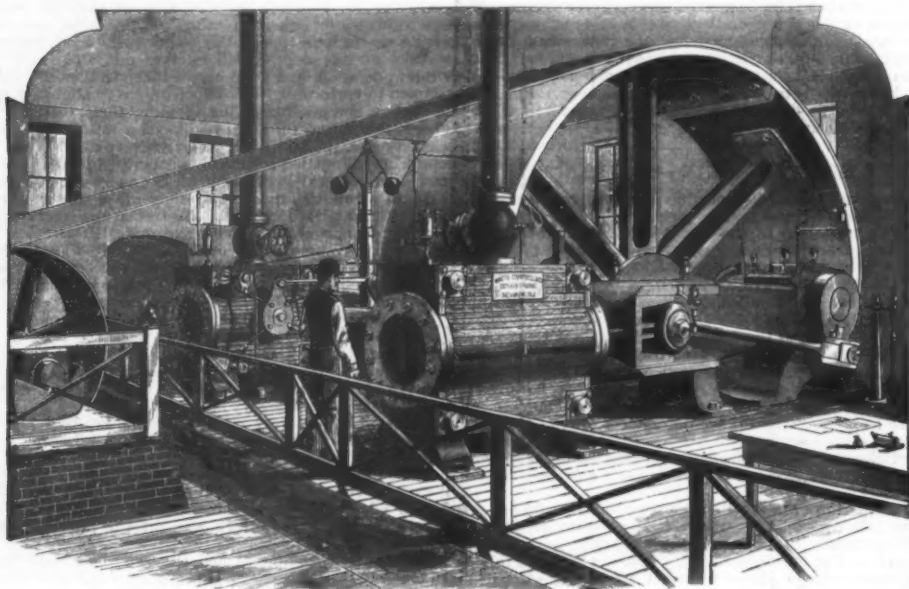
Take of—
Arnica flowers, in No. 20 powder..... 6 oz. av.
Tincture of arnica flowers..... 2 pints.
Diluted alcohol, a sufficient quantity to make..... 4 pints.

Moisten the powder with a pint of the tincture of arnica flowers, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour upon it, first the remainder of the tincture of arnica flowers, and afterward diluted alcohol, until four pints of tincture are obtained.

I have used this process with great advantage in making the fluid extract and the tinctures of cinchona.

U. S. ILLUMINATING CO.'S STATION, STANTON STREET.

THE visitor to New York, if he turns from the Bowery eastward through Stanton Street, will, when he has proceeded but a short distance, have his attention drawn to a handsome brick building of somewhat curious design. Should curiosity or other motive tempt him to enter, he will find himself, not in a well-fitted office, as the general expression of the exterior seemed to promise, but in a boiler-room resembling not a little the after-hold of a great steamship.



THE U. S. ILLUMINATING CO.'S ELECTRIC LIGHTING STATION, STANTON STREET, N. Y.—THE ENGINE ROOM.

On either side of the well-polished passage-way he will see the heads of the great steel boilers, which lie in series. Passing through an open door-way at the north end of the room, he will discover several engines at work, but so noiselessly that he will not have become aware of the fact until he has looked upon them. On inquiry, he will learn that this building, with its boilers, engines, and electrical apparatus, constitutes the principal station of the United States Illuminating Company, and that, among the electricians who have examined it, it is regarded as a model of mechanical and electrical skill and practical efficiency. From this one station there are twenty-six circuits. These extend from the Battery to 99th Street—about eight and one-half miles. Lights generated by its engines and dynamos extend from the Hudson to the East River; they light up the Battery Park, Cortlandt Street Ferry, City Hall Park, and Washington Square. On the way up-town the United States Illuminating Company's lamps, charged with electricity from the Stanton Street Station, are made to light up Broadway and Fifth Avenue.

In a great struggle between all the electric lighting companies, some time since, for the lighting of the great East River Bridge, the contract was awarded to the United States Electric Lighting Company; and so it comes that from whatever direction a ship approaches this island, whether from Long Island Sound or from Sandy Hook, the first lights it will make will be those of this company.

As said before, the Stanton Street Station is a model of its kind. Within its walls are grouped the mechanisms which, being the handiwork of the most skillful and ingenious mechanics, electricians, and engineers, have made it possible to control, virtually, the lighting of more than a score of square miles of the area of a densely-populated city from a central station—a system in which there have been few slips that engineering skill could have been expected to foresee, and not one single accident caused by blundering, stupidity, or carelessness.

From sunrise to sunset, and from sunset to sunrise, there are engineers in each department, ready at a moment's warning to make what changes are necessitated by the neighborhood of arc wires to buildings which are afire, and to look out for whatever other exigency may arise. Discipline and efficiency prevail from bottom to top of the Stanton Street Lighting Station.

The station proper consists of a building 58x100 feet. It is built of brick, with brownstone trimmings. The boiler-room is 54x47 feet. Near the partition wall, which separates the engine-room from the boiler-room, are two large chimneys, which furnish the draught for the boilers. The flue in this chimney is three feet by six feet, and 100 feet high. After leaving this room you enter the engine-room. On one side of the engine-room are located the engines, two in number. They are of the Corlies type, built by Watts, Campbell & Co., of Newark, N. J., and have given perfect satisfaction, and are peculiarly adapted to this class of work. The parts are admirably fitted, and all bearings and boxes are ground to their several places, thus making a very accurate, close working machine.

These engines drive a seven inch steel jack-shaft, which revolves at the rate of about 175 turns a minute. The belt used on this shaft is 60 inches wide and 120 feet long. This is the largest belt in operation in the city of New York, and the largest but one in the world.

The power for the dynamos is received from intermediate lines, driven from this seven-inch steel jack-shaft. The belts used on these intermediate lines are respectively 36 and 42 inches in width.

The mason-work supporting the fastenings of the seven-inch jack-shaft is put down to a depth of ten feet, laid upon Portland cement. Iron plates, 4x5 feet, on the top of this masonry support the boxes for the shaft. These are firmly bolted to the masonry beneath, and form a very substantial foundation.

There are eight horizontal steel boilers, 66 inches in diameter and 16 feet long. They were specially designed for this station. These boilers, under a pressure of 86 pounds to the square inch, generate 125 horse-power each.

In connection with the boilers, there is a Barryman heater

which feeds them with water of a temperature of 200° Fahr. There is no loss of steam in this instance, as the water is heated by the exhaust or waste heat from the engine.

The admirable arrangement of the engine-room and the working of the engines, in which the maximum horse-power with the minimum consumption of coal is at all times obtained, is due in great measure to the skill of the chief engineer, George W. Campbell, M.E., who, as might be inferred, is as well acquainted with the theory of engine construction as he is with its application.

It is safe to say this type of the Corlies engine never ap-

of dynamos to another, and without affecting the others to an appreciable extent.

The switchboard is also arranged so that the dynamos can be put on either engine. They can be readily changed from the night to the day engine. All the wires leading to this switchboard are incased in wooden mouldings in the ceilings overhead. This, besides being a very fine piece of joiner work, results in keeping the wires out of the reach of careless or maliciously disposed persons. The machinery is so designed that, in case of accident to one line of shafting, another can be at once connected by a system of clutches.

Any combination of circuits can be made with any combination of machines by means of the switchboard. The circuits are connected with the machines by cables. There is a plug on either end of the cables—one end connected with the circuits, the other with the machines. The lightning arresters are placed on each circuit. These are placed there to prevent the lightning from reaching the dynamos.

The circuits are extended from the switchboard in regular order, so that the lamps may be adjusted to each circuit. These lamps can be taken out and put in without injury to the outside circuit.

The circuits are admirably arranged, being brought in and numbered from one to forty consecutively.

The switchboard, which was designed by Mr. E. A. Scoullar, is the most compact and most easily manipulated of its kind.

There is a testing-room in the building, where all lamps are tested upon the circuit in which they are to burn, and this department is under the personal superintendence of Mr. E. T. Lynch, Jr.

The machines used in the Stanton Street Station, for both the arc and incandescent lighting, are of the same general type, the principal difference between them consisting in the winding of the armature and field coils, which is varied to produce the different qualities of current required.

The current generated by these machines is continuous, and free from pulsations, thus rendering it less dangerous.

In both the arc and incandescent systems, in the Stanton Street Station, the regulation of the machine is entirely automatic. Lights may be turned on or off at will, and a corresponding change is at once made in the current generated and in the amount of power required for driving the dynamo.

A marked peculiarity of the Weston arc system is the shortness of the arc or separation between the carbons, being about one thirty-second of an inch in length, as compared with one-sixteenth to one-eighth of an inch in other systems. This enables a given number of lamps to be worked with a current of correspondingly low tension. The comparatively low tension and freedom of the current from all vibrations or pulsations, which is true of the Weston current, is thought by many—indeed, a well-known electrician testified recently in court—that it is absolutely much safer than one which does pulsate.

From the Stanton Street Station 576 arc lights are fed, and a large number of incandescent lights.

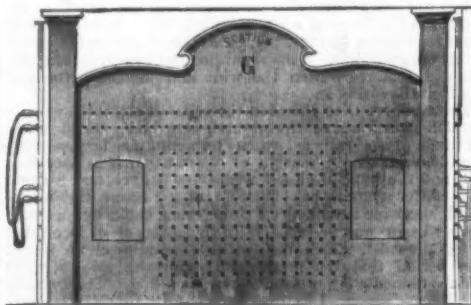
Considering how recently this station was established, this is certainly a fine showing. Incandescent lighting is to be a feature of this station. These little incandescent lights are of about 16 candle-power intensity, equaling in luminosity the ordinary five-foot gas burner. These little lights are especially designed for use in the dwelling and the office. They do not poison the air as coal gas does, neither do they throw out sulphur into the atmosphere. Glowing in a vacuum, they do not touch the air at all; indeed, the air would be fatal to them. They can be readily turned on or off, and, unlike all other species of lighting, they cannot do any injury to the youngest child, even if the little glass bulb that surrounds them were broken; for the instant this happened, the total combustion of the carbon would take place.

In this as well as in the arc system, an efficient generator is of prime importance, but economy is also largely affected by the construction of the lamps. The essential requirements of an economical incandescent lamp are efficiency in the production of light with a minimum expenditure of electrical energy and great durability.

The Maxim lamp, which is used from the Stanton Street station, fulfills these requirements in a very perfect manner. It is said to produce more light for a given expenditure of power and to last longer than most of the incandescent lamps now made. The peculiar process by which the carbon conductor is made gives it remarkable strength, durability, and capacity for withstanding the disintegrating effects of powerful currents. One of these lamps, constructed to give a light of twenty-five candles, was run for a short time at the Paris Exposition at an illuminating power of eleven hundred candles. When run at their normal candle-power, the lifetime of these lamps is very long.

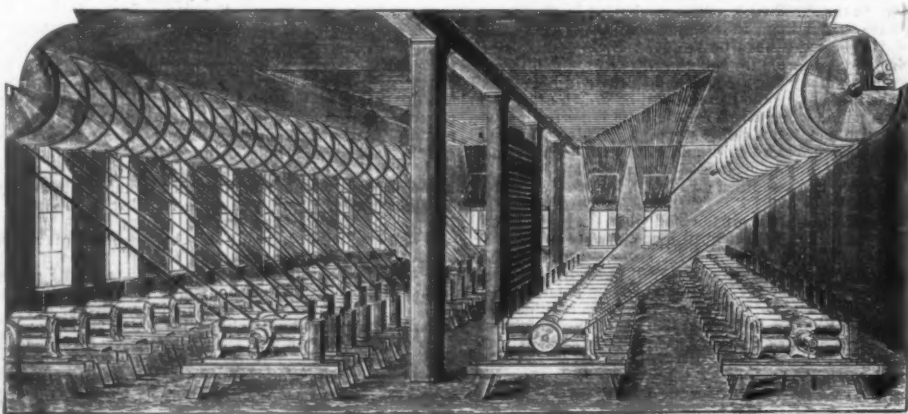
It is stated that in commercially operated plants the average life of these lamps has been found to vary from 1,500 to 2,000 hours.

Thus, as will be seen, the Stanton Street is a genuine lighting station, its patrons being by no means restricted to one system of lighting. They may have either the arc or the incandescence system, and they may rest assured when they order lights at this station that they will be well and constantly served. There is no excuse department connected with the Stanton Street electrical station. Care is taken, be-



ELECTRIC LIGHTING STATION SWITCHBOARD.

which may require inspection. In this room and the larger dynamo-room overhead, there are 60 dynamos of ten, fifteen, twenty, and thirty lights capacity each. The dynamo-rooms are in charge of the dynamo superintendent, Mr. A. E. Scoullar. There are two lines of dynamos above and below operated by the large engine; one line above operated by the small engine. The circuits from the dynamos and from the outside lines are all brought to a large and ingeniously constructed switchboard (see engraving of switchboard) by means of which the dynamos can be coupled together in any way desired. Any outside circuits can be coupled together, and any of the outside circuits can be coupled to any of the dynamos, and changed in very quick time from one battery



THE U. S. ILLUMINATING CO.'S ELECTRIC LIGHTING STATION, STANTON STREET, N. Y.—THE DYNAMO ROOM.

fore the light is turned on to a new district, that everything is in order and that the Company is thoroughly prepared to carry out the contract effectively and satisfactorily.

As said before, the arc system used here is the Weston; the Incandescence, the Weston-Maxim, and the Station are operated by the United States Illuminating Company, which is the sub-organization for this city of the United States Electric Lighting Company.

This Company is operating three other similar stations in the city; one on East 44th Street; one on Fulton Street, near Greenwich; and one on Elm Street, near Reade.—*Electrical Review*.

THE QUADRANT ELECTROMETER.

THE quadrant electrometer is one of Sir William Thomson's many and beautiful contributions to electrical science. This instrument—illustrated above—is invaluable to the electrician, enabling him, as it does, to measure with great precision, resistances and differences of potential, the insulation of condensers, and the capacity of submarine cables.

It derives its name from the four brass quadrants, which are so arranged around a common center as to inclose a small cylindrical box-like space. The opposite quadrants are joined together by a fine wire, and the two pairs thus formed are separately connected with the electrodes of the instrument, Fig. 1. It is essential that the quadrants be placed symmetrically with respect to the needle. Three of them are movable along radial slots and adjustable by hand,

As the needle is completely inclosed by the quadrants, it is thereby screened against extraneous electrification, and is, besides, kept in a constant field of electrical force. Hence the angular deflection of the needle will be constantly proportional to the difference of the potentials of the quadrants.

This deflection is measured by the displacement over a finely divided scale of the image of a narrow slit, through which rays from a lamp are admitted that are afterward reflected from a mirror in rigid connection with the needle. This mirror is a light disk of fine microscope glass, silvered and slightly concave. It is surrounded by a sort of brass hood to protect it against the influence of neighboring electrified bodies.

It is easily seen that the sensitiveness of the electrometer varies with the potential of the needle. Hence measurements are comparable *inter se* only inasmuch as this potential is maintained constant. This condition is attained by means of the *replenisher*, which accessory is merely a small but ingeniously contrived induction machine. By twirling a milled head, Fig. 1, the potential of the jar may be raised or lowered according to the direction of rotation, and, as the increments or decrements are very small, a definite charge may be accurately reproduced. This is indicated by the *idiostatic gauge*.

This gauge is itself an attracted disk electrometer. It is known that the jar has reached its normal charge when the sighting hair lies evenly between two black dots, Fig. 2, which are made on a small white porcelain plate. Errors

spheric electricity, and in this connection it has already rendered important services to meteorology.—*Engineering*.

THE REMARKABLE SUNSETS.

THE following letter, says *Nature*, has been sent to Mr. Norman Lockyer:

The remarkable sunsets which have been recently witnessed upon several occasions have brought to my recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi, and a perusal of your highly interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side, at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise we saw to our north the great peak of Illiniza, and twenty miles to its east the greater cone of Cotopaxi, both without a cloud around them, and the latter without any smoke issuing from its crater—a most unusual circumstance; indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about 45 miles south of the equator, and was distant from us 65 miles.

We had left our camp and had proceeded several hundred

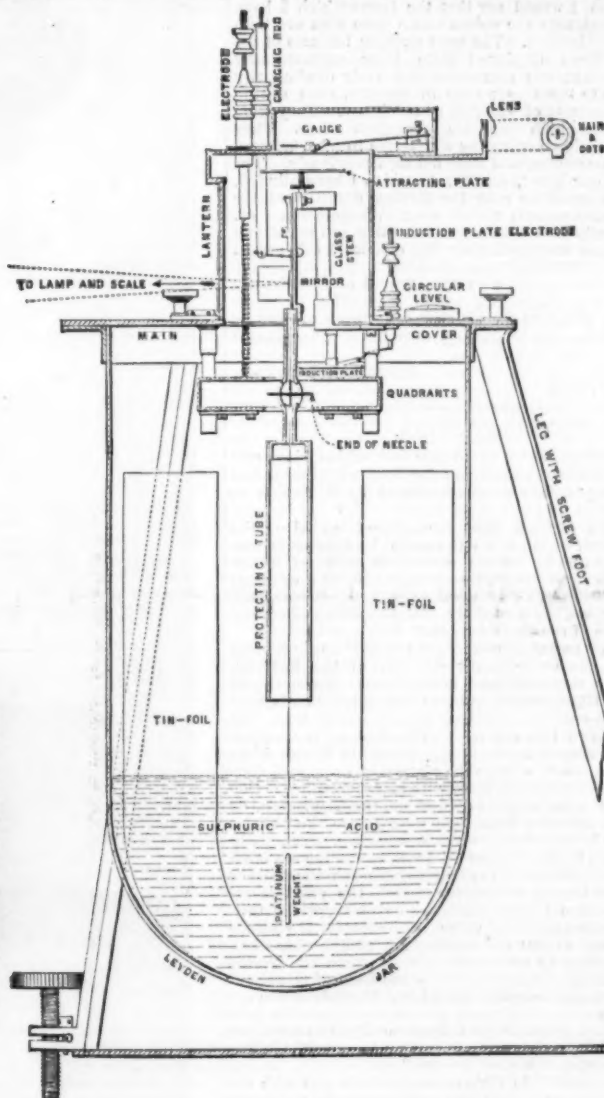
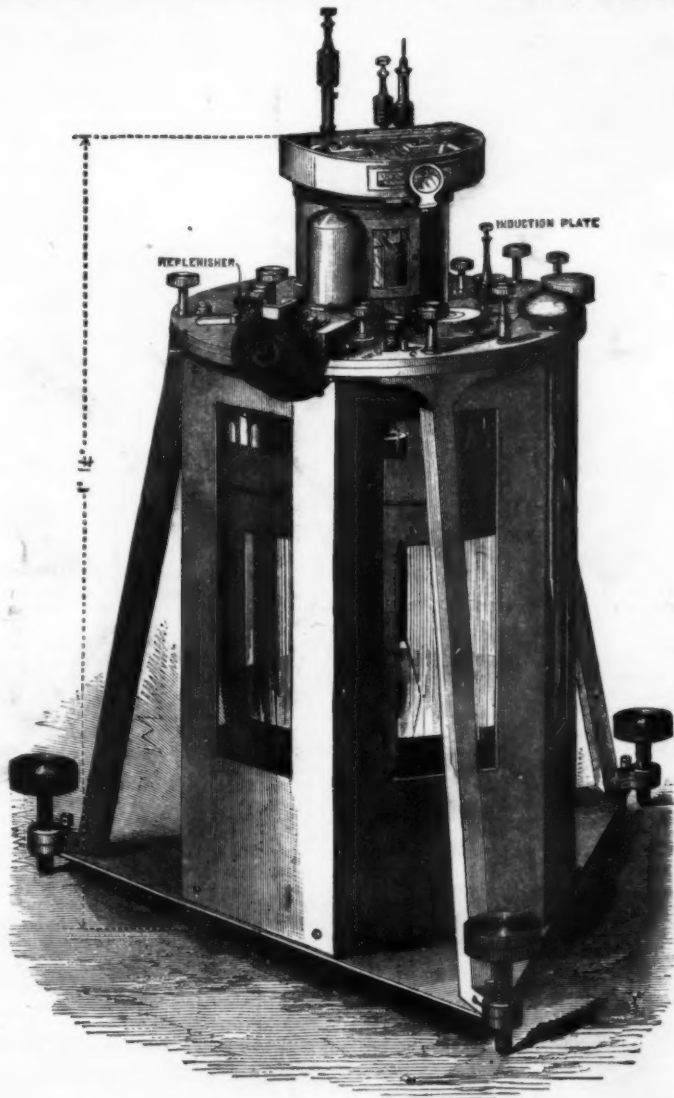


FIG. 2.

THE QUADRANT ELECTROMETER.

while the fourth is susceptible of very fine adjustment by a micrometer screw, fixed on the main cover, Fig. 1.

The "needle," which is somewhat paddle-shaped, is of thin sheet aluminum. It is freely movable about a vertical axis consisting of a stiff platinum wire. The upper part of this wire carries a short horizontal cross-piece to which are attached the two threads (unspun silk) of the bifilar suspension.

The needle is charged and kept at a high potential by being in permanent connection with the inner coating of a large Leyden jar. This coating consists of strong sulphuric acid, which, besides being an excellent conductor of electricity, has a remarkable affinity for water, so that the inner working parts of the electrometer are kept dry and well insulated. The outside coating of the jar is formed of strips of tinfoil, sparsely arranged in order that the interior of the instrument may be seen.

The dielectric is the glass of the jar, which is of white flint and carefully chosen as to quality and insulation.

A charge is given from (say) a small electrophorus to the acid by means of the charging rod, which is seen in Fig. 2 projecting from the upper semi-cylindrical part of the electrometer, technically known as the "lantern." A stiff platinum wire is rigidly connected to the needle, and carries, at its lower extremity, a small weight of the same metal which dips into the sulphuric acid. In this way, the needle is always at the same potential as the inner coating of the jar; its oscillations are, moreover, partly checked by the resistance which the acid offers to the rotation of the terminal weight. The wire is protected against surrounding influences by a narrow metallic cylinder, called the "guard case."

of parallax are avoided by viewing the hair through a plano-convex lens, taking care to keep the line of sight perpendicular to the center of the lens.

When the difference of potentials to be measured is comparatively great, the light spot may be sent off the scale. To obtain a reading in such a case it is necessary to reduce the sensitiveness of the instrument, and this is effected by means of an oblong brass strip, called the *induction plate*.

This plate is fixed immediately over one pair of quadrants, so that if one point of an electrified conductor be connected with it, instead of with the underlying quadrant, the charge in the latter will be less than if direct connection had been made, and the deflection will be correspondingly reduced.

Fixed on the main cover, Fig. 2, is a small circular spirit-level, which, together with the three foot-screws, permits of the instrument's being accurately leveled.

The readings of the quadrant electrometer may be converted into absolute measure when the *constant* of the instrument has been, once for all, determined by comparison with an *absolute* electrometer. When this determination has been made, it is evident that the position of the quadrants must not be altered, and the normal charge of the needle must always be exactly reproduced before a measurement is made.

Another means, and one of frequent use as well as of easy application, consists in comparing the obtained deflection with that given by a known difference of potential, such as that of a Latimer Clark cell or Sir William Thomson's standard Daniell.

The quadrant electrometer is also (at Kew) advantageously used as a self-recording instrument for registering, by means of photography, the variations in kind and degree of atmo-

spheric electricity, and in this connection it has already rendered important services to meteorology.—*Engineering*.

feet upward, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5:45 A.M. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for 20 miles toward the Pacific, seeming to spread very slightly and remaining of inky blackness, presenting the appearance of a gigantic inverted L, drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne toward us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer, so of course it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves, and when it did so we witnessed effects which simply amazed us. We saw a green sun, and such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris green in the sky, and they changed to equally extreme blood reds, or to coarse brickdust reds, and they in an instant passed to the color of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been

filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colors in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about midday. It had traveled (including its detour to the west) 85 miles in a little more than six hours. At 1:30 it commenced to fall on the summit of Chimborazo, and before we began to descend it caused the snowy summit to look like a plowed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils, rendered eating and drinking impossible, and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working parts of instruments and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day. That which passed beyond us must have been finer still. It traveled far to our south, and also fell heavily upon ships on the Pacific. I find that the finer particles do not weigh the $\frac{1}{1000}$ part of a grain, and the finest atoms are lighter still. By the time we returned to our encampment the grosser particles had fallen below our level, and were settling down into the valley of the Chimbo, the bottom of which was 7,000 feet beneath us, causing it to appear as if filled with thick smoke. The finer ones were still floating in the air, like a light fog, and so continued until night closed in.

In conclusion, I would say that the terms which I have employed to designate the colors which were seen are both inadequate and inexact. The most striking features of the colors which were displayed were their extraordinary strength, their extreme coarseness, and their dissimilarity from any tints or tones ever seen in the sky, even during sunrises and sunsets of exceptional brilliancy. They were unlike colors for which there are recognized terms. They commenced to be seen when the ash began to pass between the sun and ourselves, and were not seen previously. The changes from one hue to another, to which I have alluded, had obvious connection with the varying densities of the clouds of ash that passed; which, when they approached us, spread irregularly, and were sometimes thick and sometimes light. No colors were seen after the clouds of ash passed overhead and surrounded us on all sides.

I photographed my party on the summit of Chimborazo while the ash was commencing to fall, blackening the snow furrows; and, although the negative is as bad as might be expected, it forms an interesting souvenir of a remarkable occasion.

EDWARD WHYMPER.

December 21, 1883.

COCHIN CHINA.

THE present domination of France in Cochin China, and her ambitious colonial schemes in the East, will give interest to the following extracts from an address by M. Paulus on this subject:

Cochin China forms an irregular square bounded on the west by the Gulf of Siam, on the north by Cambodia and Annam, on the east by Annam, and to the southeast by the China Sea. It embraces 60,000 square kilometers, or about $\frac{1}{10}$ of France. Its shores are greatly cut by the deltas of the Mekong River, and the principal point is Cape Saint Jacques, at the entrance of the River Saigon.

It is a land of recent formation, or rather is one in process of formation from the heavy deposits of the Mekong. Every year its shores advance upon the sea. Formerly all lower Cochin China was a gulf, as inland coral reefs now show, and the granitic elevations that appear in it are the ancient islands of this old bay. The Mekong is its great river, and has created the country. It rises in Tibet, flows from north to south, crosses the plateau of Laos, and near the capital of Cambodia divides in many branches. One communicates with a great depression, the Tonle-Sap, or Great Lake; two others pour their waters into the Chinese Sea. During the rainy season the Mekong becomes greatly swollen, but its freshet instead of pressing to the sea is always diverted into the Great Lake; and when the crisis is passed and the level of the waters lowers, the currents resume their motion toward the sea. This lake, which thus opportunely acts as a safety valve for the torrential violence of the Mekong, is 180 kilometers long and 25 wide when filled, but shrinks to about half that size when the freshet subsides, or three times larger than the Lake of Geneva at its height, and much smaller when low. Myriads of fish are carried in by the freshet and left in the contracted lake afterward, when about 30,000 fishermen of all nationalities gather around its margins and fish as long as possible in this crowded reservoir.

The rivers of Cochin China communicate one with the other, by *arroyos* or natural and artificial canals, which are traversed by a crowd of barks, boats, and vessels filled with natives. The islands both of the Gulf of Siam and of the Chinese Sea were infested with pirates, and before the arrival of the French there was a constant series of attacks and captures of native junks and boats, whose booty was sold in the Chinese markets.

The climate is characterized by humid heats. There are two seasons: the dry, from October to April, during the northeast monsoon; and the rainy, from April to October, during the southeast monsoon. The temperature is 68° to 86° Fah. during the rainy season, and reaches 95° Fah. in the dry season. This heat persists through the night, and is one of the causes of the debilitating effect of the climate. The rainfall for the year is 1.64 meters, more than three times that in France. The storms are terrific, the lightning is constant, the thunder rolls, the rain falls in torrents, and the savage winds blow away the light huts of the Annamites.

Dysentery, fever, chronic diarrhoea, are the worst maladies for foreigners; cholera and smallpox for the natives. During the terrible epidemic of 1882 cholera destroyed 20,000 natives.

Cochin China is not, as Tonkin, a country rich in mineral productions, but it has a flora and fauna of surpassing wealth. Here are met all the tropical products—rice, maize, potato, sugar cane, palms, bananas, bamboo, manioc, pepper, muscade, cinnamon, cloves, coconuts, pomegranates, citrons, oranges, tea, coffee, letchi, shaddock, cocoa, cotton, tobacco, mulberry, earth nuts, indigo, gums, and numerous essences.

Rice is the common food, and a fermented drink is made from it; it furnishes in this region and the surrounding countries food for 400 millions of people. The greater part of the rice is raised upon land systematically irrigated.

Among its animals we cite the monkey, tiger, panther, rat, elephant, rhinoceros, wild boar, pig, horse, deer, cow, numerous birds, crocodiles, tortoises, pythons, and adders.

Chinese dominate in its commerce, forming almost exclu-

sively the agents or middle men between the producers and buyers. 60,000 Chinese from the Celestial Empire engage in this occupation. Cochin China is favorably placed upon the route from India to Japan, at an equal distance from Hongkong and the settlements at the Straits, a short way from Bangkok, from Manila, and Batavia. The imports and exports about balance each other, with a slight advantage for the former. The imports comprise principally the metals, tools, Chinese tea, wines of France, lime from Cambodia, paper, opium, tobacco, English stuffs, refined sugar, pottery, oil, farina, coal, preserves, pickles, and Chinese medicines.

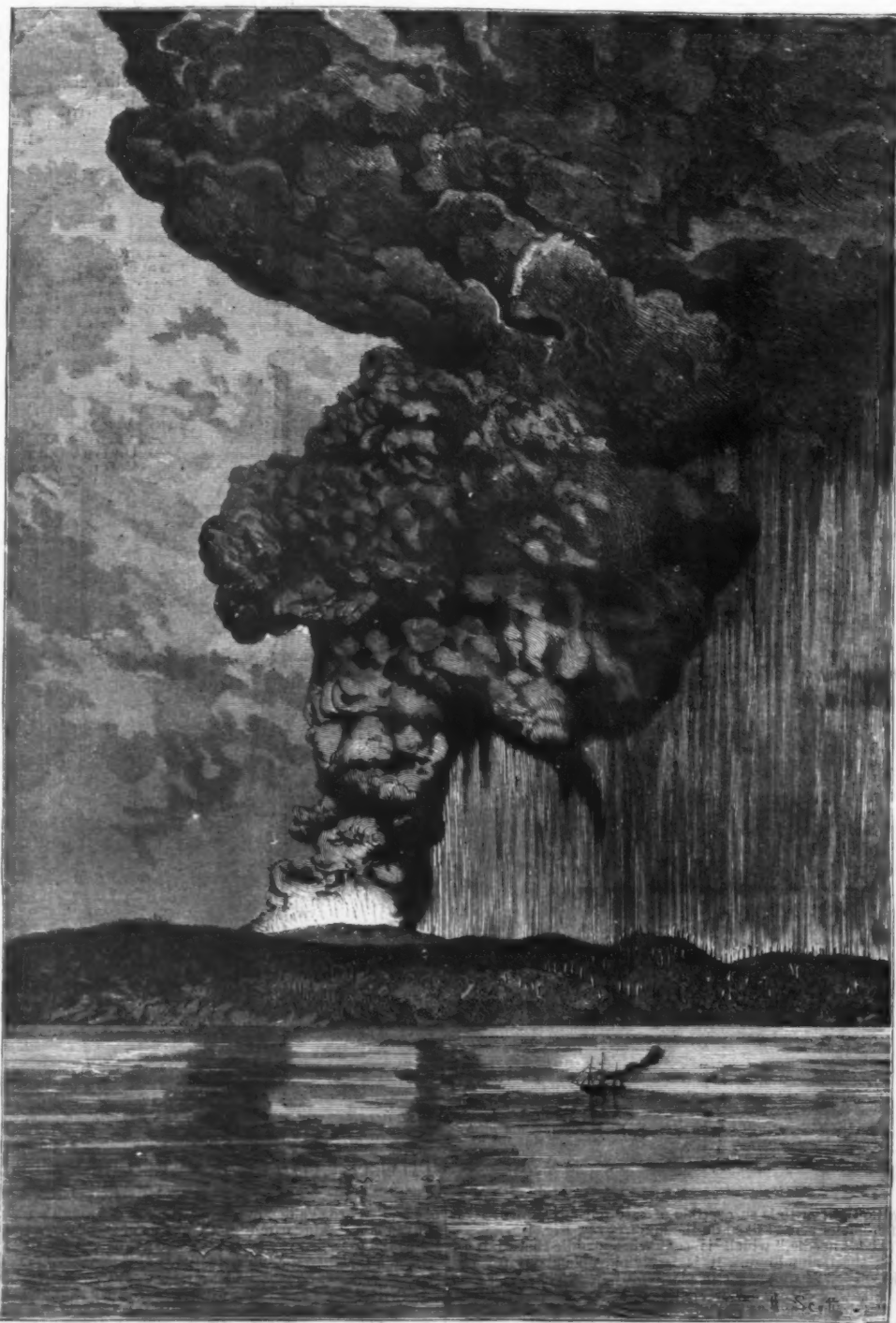
The exports are rice—this alone forms three-fourths of the entire export—dried and salt fish, cotton, dry pulse, skins, silks, pepper, oil, pork, nuts, cocoa, indigo, feathers, wax, honey, cardamom, ivory, tortoise shell, pitch, deer horns, salt, ebony, dye woods, gutta-percha, and gum lac, etc. The principal port is Saigon. In 1881, 358 steamers entered this port; the annual movement of ships is about 450 coming and going, without considering the Chinese junks and Annamite barks.

THE EARTHQUAKE IN JAVA.

We gave an account, at the time, of the terrible earthquake of the 11th and 12th of August, 1883. We publish to-day, in connection with this heartrending catastrophe, several views and a map which is of the highest interest. These were furnished to us by M. J. Van Gestel, civil engineer, who, being on the spot, was able to visit and study them before and after the disaster.

Almost opposite Anjers, in the middle of the Straits of Sunda, is the Island of Krakatoa, whose terrible volcano in its fury has overturned all this region of the Dutch East Indies. Our drawing shows it in full action. As early as May it was most violent. In August the phenomena began on the 11th.

A thick column of smoke escaping from the crater soon formed a vast crown, constantly issuing and enlarging itself. Then began the rain of ashes, followed by pumice stone mixed with lava. Then came a black, impenetrable darkness of eighteen hours, during which all the blind efforts of Nature united to renew the chaos. A furious trembling



THE GREAT EARTHQUAKE IN JAVA, 1883.—ERUPTION OF KRAKATOA.

The Government has made great exertions to facilitate communications. It has opened a network of routes, divided into colonial roads, department roads, thoroughfares, and village connections. Bimonthly steamers unite Cochin China with the civilized world. A submarine cable connects Cochin China with telegraph lines to India, Europe, Japan, and Siberia. —*Revue Scientifique.*

As regards transplanting the strawberry, possibly some readers may be ignorant of one portion of the process, which to every one making a plantation in a dry time is well worth knowing. In preparing the plant, do not pull off the runners, but leave, say, six inches of them attached to each side of the plant. Bend these ends of runners down, and bury them with the roots. Plants thus provided with these "umbilical cords" on which to draw for nourishment will survive and flourish in adverse conditions under which plants denuded of their runners will almost inevitably perish. The practice of this precaution in transplanting is equivalent to almost complete insurance of success, in spite of the weather. —*Country Gentleman.*

sea arose. A colossal wave gathered in the strait, and traveling with incredible rapidity rolled furiously inland. Others followed, equally gigantic and destructive, pursuing their work in the middle of the darkness. When, finally, daylight appeared, pale and uncertain, it was to light up a lamentable and frightful spectacle. Villages full of life, movement, and noise had entirely disappeared. Among these were Telok-Betong, at the head of the Bay of Campong on the Island of Sumatra; in Java, Bantam, Anjer, Tjeringin, all the coast towns, and the coast itself. The waters had advanced inland over the entire extent shown on our map by the dark lined portion, allowing only the tops of high mountains to emerge like small islands. And such was the force of the waves that they had in some cases thrown ships, boilers, and locomotives against mountains as far as three kilometers, or about two miles, inland.

Where the line of water ended, that of ashes began. The whole island was covered with the latter; vegetation was destroyed and wells and water courses filled and stopped; and the unfortunate people in the midst of this bleak desert died of hunger and thirst by thousands.

During this time changes, equally as terrible, had taken place in the Straits of Sunda. It was no longer possible to enter the Bay of Lampong, on account of the accumulation of pumice thrown out by the volcano in that vicinity. When M. Van Gestel left that region no ship had as yet been able to enter. All the islands of the Strait had been more or less cruelly treated. One-half each of the islands of Krakatoa (prime cause of the disaster), of Sebesie, and of Seboukou had sunk below the waves. The whole northern part of Krakatoa, which the map shows by shaded lines, is to-day covered by more than 300 meters (1100 feet) of water. There remains only the southern part, with the great peak. At the same time, sixteen small islands had risen from below the surface of the water, between the islands of Krakatoa and Sebesie. The black spots indicate their situation on the map. Finally, in the narrow portion of the Strait, the Island of Dwar in den Weg (literally in the way) was divided into four parts and formed four islands, and in addition a new islet rose from the sea to the south of these.

The frightful number of deaths by the earthquake has been reported, but it is certainly below the actual figure, for at the time of writing the entire extent of the disaster had not yet been determined. The latter was perhaps the greatest that ever occurred within historical times, and we may add that in comparison with it the burying of the ancient cities of Herculaneum and Pompeii appears as of little importance.—*L'Illustration*.

POMPEII.

Who that has an object before him ever grows tired in Pompeii? As I have said, the aspect of the local museum is smart. It glimmers with its polished oaken fittings and glass cases. The pots and pans, the fishhooks and stirrups, the calcined loaves and fruits and nuts that have almost, but not quite, brought me face to face with the people of A.D. 79 are from carbonization black, but they are comely. The whole room looks bright and cheerful, yet on every side are there mementoes of death, sudden, violent, and terrible. Ranged round the walls are skeletons of men, women, infants, horses, mules, dogs, cats, and poultry, all

and made to vanish in a moment. But the *aqua bollante*, the boiling vapor permeating the pumice, the scoriae, and the ashes formed around each body a fine paste, which received the imprint of the corpse which it surrounded. This paste after some days dried, and became a sharply defined mould, and then came the eighteen centuries of entombment. The bodies decayed, the bones fell away from ligaments which turned to dust, but the sharp mould remained, retaining every detail of the external form of what had once been human. And one day Cavaliere Fiorelli, superintending the proofs of the "scavi," was told by one of the workmen that with his pickaxe he had struck into a cavity apparently of considerable dimensions. The cavity was sounded, and by and by some vestiges of mortality—a vertebra, a bone of a tarsus or metacarpus, was brought to the surface. It instantly occurred to the astute mind of Cavaliere Fiorelli that a human body had once filled that cavity, and that the long-since indurated mass of pumice and ashes had formed a mould which should present an exact imprint of the disintegrated corpse. Liquid plaster of Paris was brought, and poured through the aperture of the cavity. The plaster was allowed to harden, and then the surrounding mould was gently removed, and these astonishing transcripts of life suddenly turned into death were revealed. In only one of these bodies, strangely resuscitated—if the paradox can be pardoned—by means of a bucketful of liquefied plaster of Paris, are any signs of acute physical suffering visible. There is a reproduction of the body of a dog which, with a collar round its neck, was found by the side of the vestibule of a patrician's house. The poor dog had died hard, it has rolled over in its agony and lies on its back, its mouth open, its limbs violently contorted. The stretched out fore-paws are crossed almost in an attitude of supplication; and the whole frame is twisted and wrenched in a manner suggestive of fearful pain having been suffered ere the relief of death came.—*London Telegraph*.

CONCILIATION.

THERE is hardly anything more necessary to the peace and harmony of domestic and social life than a spirit of concilia-

matters is alike irritating and useless, and leaves an unpleasant impression behind that no kind actions can efface, while it weakens their influence over him in really important matters. They do not perceive the soothing and pleasurable effects of persuasive gentleness, and cannot estimate the power of conciliation.

Sometimes this lack of conciliatory spirit comes from a persistence which fails to distinguish between important and unimportant matters. To be firm in principle and firm in right doing is very different from that petty obstinacy which quibbles over every difference of opinion and insists on every trifling detail, to the weariness and discomfort of every one. It is a wise man who knows where to be firm and where to be yielding, and the latter knowledge is by no means the least important. There is no greater mistake made than in imagining kindness to consist wholly or even chiefly in actions. There are benevolent people who stint neither time, labor, nor money for the good of their fellow men, but who do it all in so ungracious a manner that gratitude is stifled, and only an unpleasant burden of obligation remains. There are parents who spare nothing for their children's benefit, and would sacrifice ease, comfort, and even life itself for their sakes, and yet are so unconciliating in their words and manner that their presence causes no glad smile or loving welcome from those thus deeply indebted. There are friends and relatives who sincerely love each other, and would do much to prove it, yet who perill and sometimes extinguish that love by disregarding, or criticising, or ridiculing tastes and preferences, innocent in themselves, but not happening to agree with their own. Arthur Helps, writing on the "Art of Living with Others," says:

"Conciliating those we live with is most surely done, not by consulting their interests, nor by giving way to their opinions, so much as by not offending their tastes. . . . The taste is the region of our most subtle sympathies and antipathies."

It is often easier to make great sacrifices than little ones; to right some great wrong than to prevent a multitude of small ones. It is easier to do battle for a grand idea than to give up a prejudice, to establish a man's right to citizenship than to respect in silence his right to dress as he pleases. Yet it is the little things of life that contribute most largely to its fret and worry, or to its peace and gladness; and he who possesses the true spirit of conciliation knows that no right is too small to be respected, no kindness too trifling to be rendered, no part of life too insignificant to command consideration.—*Philadelphia Ledger*.

GOSSIP ABOUT DARWIN.

In a recent visit to England, the writer strolled into the village of Down in Kent, and talked with some of the villagers in regard to Mr. Darwin, whose beautiful home is just outside the little town.

Some of this talk, although in itself idle and valueless, may have an interest to readers, as showing how a great man looks to his smaller neighbors.

The landlord of the "George Inn" said that "all the people wished to have Mr. Darwin buried in Down, but the government would not let them. It would have helped the place so much. It would have brought hosts of people down to see his grave. Especially it would have helped the hotel business, which is pretty dull in winter time."

"Mr. Darwin was a very fine-looking man. He had a high forehead, and wore a long beard. Still, if you had met him on the street, perhaps, you would not have taken much notice of him unless you knew that he was a clever man."

"Sir John Lubbock (Darwin's friend and near neighbor) is a very clever man, too, but not so clever nor so remarkable-looking as Mr. Darwin. He is very fond of hants (ants) and plants and things."

At Keston, three miles from Down, the landlady of the Greyhound had never heard of Mr. Darwin until after his death. There was then considerable talk about his being buried in Westminster, but nothing was said of him before.

Several persons had considerable to say of Mr. Darwin's extensive and judicious charity to the poor. To Mr. Parslow, for many years his personal servant, Mr. Darwin gave a life pension of £50 and the rent of the handsome "Home Cottage" in Down. During the time of a water famine in that region, he used to ride about on horseback to see who needed water, and had it brought to them at his own expense from the stream at St. Mary's Cray.

"He was," said Mr. Parslow, "a very social, nice sort of a gentleman, very joking and jolly indeed; a good husband and a good father and a most excellent master. Even his footmen used to stay with him as long as five years. They would rather stay with him than take a higher salary somewhere else. The cook came there while young and staid there till his death, nearly thirty years later."

"Mrs. Darwin is a pleasant lady, a year older than her husband. Their boys are all jolly, nice young fellows. All have turned out so well, not one of them rascally, you know. Seven children out of the ten are now living."

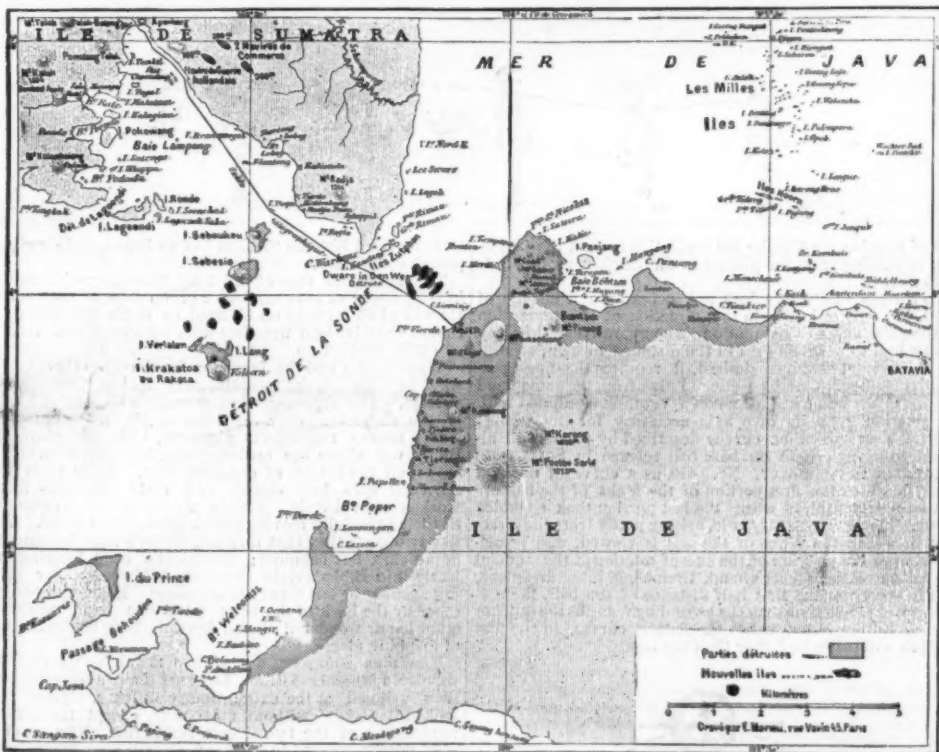
"George Darwin is now a professor in Oxford. He was a barrister at first; had his wig and gown and all, but had to give it up on account of bad health. He would have made a hornament to the profession."

"Francis Darwin is a doctor, and used to work with his father in the greenhouse. He is soon to marry a lady who lectures on botany in Oxford."

"For the first twenty years after Mr. Darwin's return from South America, his health was very bad—much more than later. He had a stomach disease which resulted from sea-sickness while on the voyage around the world. Mr. Parslow learned the watercure treatment and treated Mr. Darwin in that system, for a long time, giving much relief."

"Mr. Darwin used to do his own writing, but had copyists to get his work ready for the printer. He was always an early man. He used to get up at half-past six. He used to bathe, and then go out for a walk all around the place. Then Parslow used to get breakfast for him before the rest of the family came down. He used to eat rapidly, then went to his study and wrote till after the rest had breakfast. Then Mrs. Darwin came in, and he used to lie half an hour on the sofa while she or some one else read to him. Then he wrote till noon, then went out for an hour to walk. He used to walk all around the place. Later in life, he had a cab, and used to ride on horseback. Then after lunch at one, he used to write a while. Afterward he and Mrs. Darwin used to go to the bedroom, where he lay on a sofa and often smoked a cigarette while she read to him. After this he used to walk till dinner-time at five. Before the family grew up, they used to dine early, at half-past one, and had a meat-tea at half-past six."

"Sometimes there were eighteen or twenty young Darwins of different families in the house. Four-in-hand coaches of young Darwins used sometimes to come down



MAP OF A PORTION OF THE ISLAND OF JAVA, SHOWING THE STRAITS OF SUNDA, AND THE NEW ISLANDS THROWN UP BY THE GREAT EARTHQUAKE OF 1883.

dug from the ruins. Stay, the little sucking pig yonder, that was found in the baker's oven, escaped a violent end. He had been mercifully stuck to death before they scored and trussed him for the bakehouse. His tender crackling, the gristle of his snout, his ears and eyes have long since been resolved into dust and ashes, but the osseous structure of the tiny creature is yet perfect, even to the bones of the pettiottes and the vertebrae of the once curly tail. Plum sauce and not pumice stone should have crowned the funeral pyre of that little pig. How brown and shiny he must have been growing, how nice he must have smelt, when the black rain of ashes came down upon him and covered him up for eighteen centuries!

But the middle of the museum; what is there in the midst of the museum? Sudden, violent, and dreadful death, the aspect of which is almost supernaturally revealed to us, but which bears no appalling look. I have rarely known a civilian who, having once been over a field of battle, say three days after the slaughter, exhibited the slightest desire to make a second time that journey full of horrors. Yet there is nothing shocking, and scarcely anything, indeed, that can be called painful, in the appearance of the images of death ranged at full length on the tables. The prostrate figure of the man who, from the aquiline outline of his countenance, is known as the Roman, and who is girt with a money belt. His death must have been from asphyxiation. His head reposes on one of his arms; the expression of the countenance is one of deeply thoughtful gravity, scarcely sleep, although the eyes are closed, but rather profound meditation. And then the *regulus*, the boy of eleven or twelve summers, who has tumbled face foremost on the ground, and died there in a moment. And the *regulus*, the exquisitely formed young girl of sixteen or seventeen, her face turned a little on one side, so that you can see her sweet, innocent features, and her hair fixed in girlish coquetry. These images of sudden and violent death are all nude; but when they were stricken down by death they wore the garments of their time and rank—garments which the heated ashes calcined

tion. Justice and kindness are the foundations of all social happiness, and any superstructure that does not rest upon them will eventually crumble to dust; yet, as they are generally interpreted, they are not sufficient of themselves to constitute the full happiness of a social circle. They would be so, without doubt, did we carry them out to their full extent, but they are commonly limited to what we are pleased to call the important things of life; and these fulfilled, we consider the claims of justice and kindness to be satisfied. Thus there are men and women who are considered both just in their dealings and kind in their disposition—who would not willingly hurt or injure any one, yet who do both continually by a series of petty persecutions. They are most difficult persons to live with pleasantly, simply because they do not take pains to conciliate. They are persistent about trifles, or rough in their manner; or careless of the amenities of life, or regardless of other people's preferences, or unnecessarily plain spoken and critical; and in these and other ways are constantly wounding some one's sensitiveness, and producing a repulsion of feeling, where there need be only cordiality and friendship. Such persons are often surprised and pained to find that they are neither sought nor welcomed, that their coming is never hailed with pleasure nor their departure made a subject of regret. They are unconscious of having committed any injustice; they know they have done many kind actions; perhaps they are naturally affectionate and crave affection in return, and it seems to them that other people are very ungrateful and unappreciative. They are indeed deserving of sympathy, for they are generally profoundly unconscious that the trouble lies in themselves. Sometimes this proceeds from a lack of delicate perception. They are not quick to read another's feelings, they do not see that what they are saying or doing is rasping the nerves of one and wounding the sensibilities of another. They do not discern the vast differences of temperament and education, habits and tastes, that exist, but conclude in a sweeping way that what is good for one must be good for all. They do not notice that to antagonize a person in trifling

from London. Mr. Darwin liked children. They didn't disturb him in the least. There were sometimes twenty or thirty pairs of little shoes to be cleaned of a morning, but there were always plenty of servants to do this.

"The gardener used to bring plants into his room often of a morning, and he used to tie bits of cotton on them, and try to make them do things. He used to try all sorts of seeds. He would sow them in pots in his study.

"There were a quantity of people in Westminster Abbey when he was buried. Mr. Parlow and the cook were among the chief mourners, and sat in the Jerusalem chamber. The whole church was as full of people as they could stand. There was great disappointment in Down that he was not buried there. He loved the place, and we think that he would rather have rested there had he been consulted."—David S. Jordan, Bloomington, Indiana, in *Amer. Naturalist*.

APPROXIMATION OF SQUARE ROOT.

To the Editor of the Scientific American:

With reference to the article on "Some Hitherto Undeveloped Properties of Squares," published in your number of 23d September last, I think the method I have devised for approximating to the square roots of any number by simple multiplications and a final division would be a useful addendum.

The two following examples will make the process apparent to the merest tyro. We commence by choosing a square number which shall differ by 1, 2, or 4 from the number whose square root is desired, or that number multiplied by a square number. For instance, the square root of 7 is required; we choose 9, which differs from 7 by 2, and we get the equation $9 - 2 = 7$. We multiply both terms by 3, giving $3^2 - 2 \times 3 = 7 \times 3$. The first term can be reduced to $3^2 - 2 \times 3 + 1 - 1$ (or $3^2 - 1^2$). We thus get $8^2 - 1^2 = 7 \times 3$. This we multiply by $(2 \times 8)^2$, giving $4 \times 8^2 - 4 \times 8^2 = 7 \times 3 \times 16^2$, or by adding and subtracting one from the first term $(8^2 - 1^2) \times 16^2 = 7 \times 3 \times 16^2$, and simplifying $127^2 - 1^2 = 7 \times 3 \times 16^2$, which we multiply by $(2 \times 127)^2$, and we get by the same process $(2 \times 127^2 - 1^2) \times 16^2 = 7 \times 3 \times 16^2 \times 354^2$. The first term is simplified into $32257^2 - 1^2$. We thus get $\frac{32257^2 - 1}{12192^2} = 7$ or $\frac{82257}{12192} = \sqrt{7}$

$= 2.64575131$ with an error of $\frac{1}{12192^2}$ which does not affect the eighth decimal place.

In the following example I put the process in a tabular form, which shows the facility of working it out. The square root of 773 is required. By trying the squares of the first five numbers, and with the help of a table of squares, we soon find $139^2 + 4 = 773 \times 5^2$, and the process is carried on thus:

Dividend	Multiply by	Divisor
$139^2 + 4$	139^2	773×5^2
$19323^2 - 4$	19323^2	$5^2 \times 139^2$
$37337837 - 4$		$5^2 \times 19323^2 \times 19323^2$
Therefore,		
37337837		
$13439485 = \sqrt{773} = 27.80287754801509$, true to 14 places of decimals.		

You will perceive the advantage of this method if the approximation is required in the form of a vulgar fraction, as then the division, which is the most laborious part of the operation, is not needed.

GEO. COOD.

Santiago, Chile, November 9, 1883.

MOVEMENT OF THE MAGNETIC MERIDIAN.

To the Editor of the Scientific American:

A. W., a correspondent, asks the following question in your issue of Nov. 10, 1883, page 398: "What time in years it takes the magnetic pole to make one revolution round its circle, and the radius or diameter of that circle as near as it has been discovered?"

The most ancient observations of the movement of the magnetic meridian were made in Paris. At that place in 1541 the needle pointed 7° east of north; in 1580 the variation had reached $11\frac{1}{2}^\circ$ east of north, being its maximum; the needle then began to move westward, and in 1666 it had returned to the meridian; the variation then became west, and continued to increase, till in 1814 it registered $23^\circ 34'$ west of north. It is now receding, and in 1853 was $20^\circ 17'$ west, and will continue to recede till it again reaches 0.

We see from this, that the time in years, at Paris, it took the magnetic meridian to make one revolution was, from 1580, when the variation was at its easterly maximum, to 1814, when the variation was at its westerly maximum = 234 years, and that its diameter in degrees must be $11^\circ 30' + 23^\circ 34' = 34^\circ 04'$.

Let us take another case, as observed in London. In 1580 the magnetic meridian was $11^\circ 30'$ east, being at its maximum; in 1657 it had receded to zero. It then commenced a westerly movement, and reached its maximum of $24^\circ 38'$ in 1818. From this, we see that the time of one revolution at London was 238 years, and its diameter $35^\circ 58'$.

In the U. S. this movement of the magnetic meridian has not yet been observed a sufficient length of time to definitely fix the measure of one revolution and its diameter.

There is a line of no variation passing around the globe, and which runs through the U. S., passing through Lake Erie, as it enters, and making its exit a little west of Cape Hatteras, N. C. East of this line the variation is west, and west of it the variation is east, and upon the line the needle points to the true pole.

ORLON HARMON.

Oneonta, Jan. 7, 1884.

BASE BALL SCIENCE.

To the Editor of the Scientific American:

The theories of the base ball curve, as illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 402, do not bear investigation as illustrating the law of projectiles revolving upon an axis coincident and parallel with the direction of their discharge. It is a well known law that gravity has but one direction, and that direction is in a vertical plane cutting the trajectory or line of flight. A shell discharged from a rifled gun takes a revolving motion parallel with the direction of the gun at the moment of discharge. This axis of revolution has an increasing inclination to the trajectory during the flight of the shell, as illustrated in Fig. 1, where A B represents the axis of the gun, and C D the axis of rotation of the shell toward the end of its flight. By inspection it will be seen that the motion of the shell

forward is not in the line of its revolution upon its own axis, and that the impact of the air is in the direction of the trajectory and upon the side of the shell, which by virtue of its revolution makes the impact unequal upon the two front quarters of its progress. This has a tendency to deviate the course of the shell to the right or left of the vertical plane of its initial projection, according as the gun has a right or left handed rifling.

The theory of Mr. Houston, as illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 410, applies this principle to the formation of the deviating curve. There is no doubt that the theory of the rotation of the ball upon a nearly vertical axis is the real cause of the deviation of its course from a vertical plane. The other curves as their deviation from the true or proper line of their trajectories either downward, upward, or the double curve, or the snake like curve, can be realized as being the first curve twisted around the true trajectory by the revolution of the axis of rotation; or in other words, the two motions produce a spiral line of flight, in which, to accomplish a double curve as seen from above, the

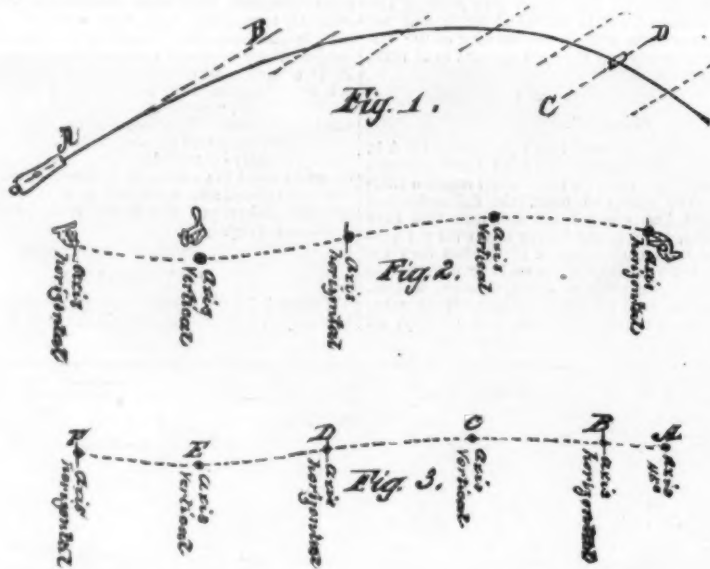
coincide with the depression of the line of the trajectory, as shown by the dotted line.

There appears to be no mystery in these movements and curves, but all accord beautifully with the well known laws of momentum under the influence of gravity and the impact of statical matter.

G. D. HISCOX.

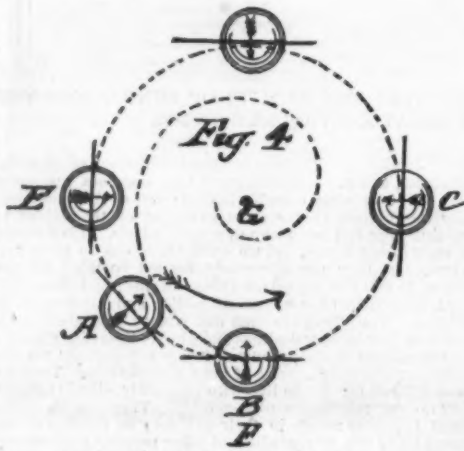
HOW TRAINED WRESTLERS USE THEIR STRENGTH.

WHEN two modern wrestlers approach each other, the spectator is instantly reminded of cats. The agility, elasticity, and springiness of wrestlers is more impressive than their strength. They move stealthily and stand without effort in an attitude that the majority of men would find it impracticable to assume. They plant their feet sideways about a yard apart, neither in advance of the other, and gradually bend forward until their backs are at right angles to the perpendicular of their legs. Then they throw their sinewy



axis of rotation must make one revolution around the trajectory in passing from the pitcher to the catcher, as illustrated in Fig. 2.

To reverse this curve does not necessitate a change of hand, but only a change in the direction of the revolution of the axis, and as this motion is comparatively slow, say from a half to a whole turn in the distance thrown, according to the kind of curve desired, it requires the finest perception, judgment, and practice to give from the same hand this half, three-quarters, or whole revolution combined with the rotation upon its own axis necessary for the greatest effect. There are other curves described by parties and alluded to in the article on base ball science in SCIENTIFIC AMERICAN SUPPLEMENT, No. 410, as a curve of unequal parts, in which the first portion of the flight of the ball appeared nearly straight while the last portion took a sudden curve. This is apparently true, arising partly from the direction in which the flight of the ball is viewed, and principally from the position of the axis of rotation at the moment the ball leaves the pitcher's hand. Premising, in the first place, that in every case the first half distance of the ball, flight is performed in less time than the second half, and as the quicker motion in translation makes the flattest curves, so the first portion will really be flatter than the last.



The point above mentioned of the position of the axis of rotation at the moment of leaving the hand may be illustrated thus, as in Fig. 3 and Fig. 4.

Let G in Fig. 4 represent the line of flight or trajectory of a ball projected without local motion of any kind, then the circle, A B C D E, will represent the position of the axis of the ball at the corresponding points in Fig. 3, while the spiral dotted line, Fig. 4, represents the relative position and distance from the mean central line of the trajectory through the course of its flight.

When the ball is made to revolve quickly upon its own axis, and its axis of rotation made to turn slowly, or equal to one and one-quarter turns around the axis of the trajectory in the length of its flight.

Starting at A 45° , at B horizontal, at C vertical, at D horizontal, and caught at E vertical.

It will occur upon inspection that the flight of the ball under these conditions will appear to swing from A to C in nearly a straight line, because the curve of flight and the curve of the trajectory are opposite curves, while the flight from C through D E F will appear elongated vertically, to

arms forward like the "feelers" of an insect, and slowly approach each other.

The ambitious man of full habit who essays this attitude in the privacy of his chamber will do one of two things. He will pitch forward on his head or strain his back. He cannot conceive how wrestlers walk backward and forward so oddly doubled up.

When Bibby and the Japanese faced each other in this way in New York recently, they looked uncouth and strange. The Japanese was a wrestler who was considered by the champion over all others in his own country, and was a man of magnificent physique, while his competitor Bibby was above the ordinary size, but they both seemed only half the height of ordinary men. Their faces were set, their eyes half closed, and their tenacious fingers worked convulsively. Slowly they waddled forward until their gracefully moving arms almost intertwined. Then like two goats they shot forward, Bibby's head bunting into Sorakichi's left shoulder; Sorakichi's head banging violently into Bibby's right shoulder; Bibby's left ear grinding against the left ear of the Japanese. Each grasped the other by the back of the neck with one hand, while the other hands wandered up and down the long bodies in search of gripping places.

The man who saw a wrestling match for the first time wondered whether the men had hurt their heads much, and then grinned at the extraordinary attitude. They stood locked together without movement, except the constant restlessness of the two sinewy right arms. The spectator was mildly amazed to see that both men were in a dripping sweat. Then he noticed the prominence of the huge ridges of muscles on the backs of the athletes and the whiplords that stood out on their arms. The Japanese raised one foot slightly and then brought it down with a resounding blow on the platform. The spectator who had never before seen a match discovered all at once that the two men were not leaning comfortably against each other, but were putting out all their tremendous strength.

Bibby's right arm had been working its way like a sinewy snake inch by inch around his opponent's body. His fingers stretched out, almost dug their way into the chocolate colored flesh of the Oriental, and then the hand closed, bringing the arm still further around the body of the Japanese. Suddenly the men whirled around, their feet striking the platform like trip hammers. Once they rolled over together with feet and hands flying around like cat's claws. Both panted hotly. Bibby kept his grip. There was an instant's struggle, and then the Japanese flew up into the air with his legs and arms squirming like a turtle's. Bibby rose as he threw his antagonist over his head, and stood erect for an instant like a Hercules. The Japanese fell on his side on the stage, but as he fell Bibby jumped upon him as a cat does upon a mouse. One could not help feeling a pang of pity for the Japanese. The situation was a beautiful and forcible illustration of the efficacy of jumping on a man's chest when you get him down. At the instant the Japanese struck the floor the Englishman was on him. There was a fierce struggle, the sweating bodies of the men squirming. The Japanese made a last despairing effort; then with a gasp he submitted, and his shoulders were forced to the floor.

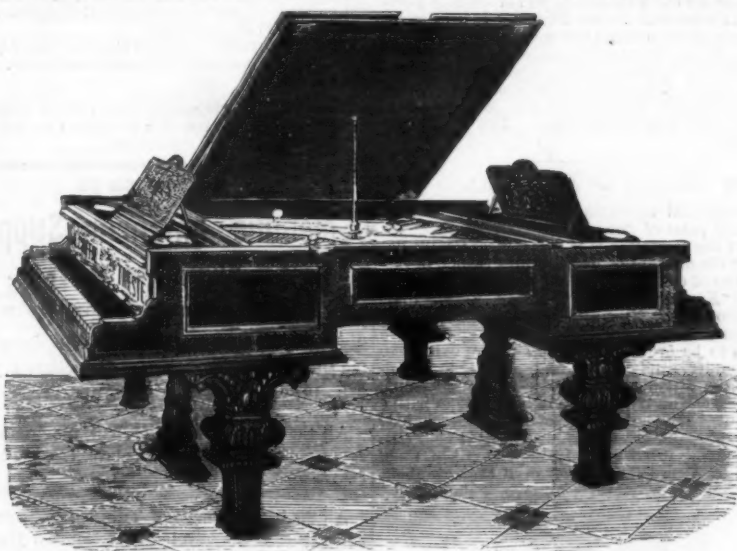
STUMBLING HORSES.

THE *Pittsburg Stockman*, in a recent issue, says: "Some good horses are addicted to stumbling while walking or moving in slow trot. A well-versed veterinarian states that there are two causes that would tend to produce this faulty action: one a general weakness in the muscular system, such as would be noticed in a tired horse; the other a weakness of the exterior muscles of the leg, brought about by carrying too much weight on the toe. To effect a cure, he adds, lighten the weight of each front shoe about four ounces, have the toe of the shoe made of steel instead of iron, it

will wear longer; have it rounded off about the same as it would be when one-third worn out, in order to prevent tripping; allow one week's rest; have the legs showered for a few minutes at a time with cold water through a hose, in order to create a spray; then rub dry, briskly, from the chest down to foot. Give walking exercise daily during this week for about an hour twice a day. When you commence driving again omit the slow jog, either walk or send him along at a sharp trot for a mile or two, then walk away, but do not speed for at least several weeks. By this means the habit of stumbling from either of the above causes will be pretty well overcome."

DOUBLE PIANO.

Our cut shows a form of piano now in use in Germany, in which two keyboards and double strings are arranged in one



IMPROVED DOUBLE PIANO.

case, forming a very convenient instrument for the rendition of duets and other musical combinations.

PHYSICS WITHOUT APPARATUS.

In a former number we gave a method of converting a bottle into an air-pump that sucks in a hard-boiled egg deprived of its shell, but thus far our *Physics without Apparatus* has been wanting in experiments upon the compression of gases. One of our correspondents has supplied this deficiency by communicating the following experiment, which consists in blowing out a candle by means of air compressed in a bottle with the mouth.

An ordinary bottle is taken whose neck has an internal diameter of about two centimeters. Holding the bottom of this in the right hand, the palm of the left, or, more accurately, the fleshy part, A, of the thumb (Fig. 1), is pressed against its mouth in such a way as to nearly close it. Care must be taken to leave but a small unstopped interval at the side. This done, the experimenter must apply his mouth against this small opening, and, by a gradual exertion of his lungs, compress the air in the bottle.

Under such circumstances it is evident that, as a consequence of the communication which exists between the interior of the bottle and the lungs, an equilibrium will soon occur in the pressure. Three to four seconds are amply sufficient. At this moment, through a quick twisting of the left wrist, the bottle is completely closed by applying the fleshy part of the thumb strongly against its entire mouth. By this movement of the wrist the experimenter pushes aside his mouth, which, during this entire maneuver ought not to cease to act as long as the bottle has not been entirely closed.

In this state the bottle is placed in an inclined position, bottom upward (all the time held by the right hand) and the mouth downward. The latter is then brought near a lighted candle, at about three centimeters from the flame. At this moment its mouth must be partially freed by a sudden

motion of the left wrist, and one contrary to that which effected the closing of it, so as to allow the compressed air to escape through an opening about equal to that through which the insufflation was performed. (Fig. 2.)

It is important that the mouth of the bottle shall be placed in such a position above the flame that the escaping jet of air shall be directed obliquely downward and aim at the wick of the candle.

When such conditions are fulfilled, the extinction of the flame never fails to occur. This experiment is interesting, and always surprises those who see it for the first time.—*La Nature*.

NOTEWORTHY TREES AND SHRUBS.*

DURING the last few years several beautiful and valuable new trees and shrubs have appeared. It is, therefore, my

purpose in this paper to refer briefly to some which we have tested and consider most entitled to the consideration of planters. Taking up the family of maples first, we have the Japanese species and varieties, which, after having been tried in various soils and localities, have, so far as I can learn, proved to be nearly hardy. It affords me much pleasure to furnish favorable evidence relative to this important qualification, for when these maples were sent out a few years ago, many persons, myself included, doubted their value for out of door decoration, supposing them to be too tender to resist successfully the severity of our winters. However, being greatly interested in them on account of their extraordinary beauty, we imported fine plants of the choicest varieties direct from Japan, gave them a fair trial, and now have large specimens doing finely upon our lawns at Rochester, where they have stood out unprotected the last three winters. Our experience is that young plants, until they become well established, are liable to suffer injury from extreme cold. Hence spring planting is recommended for them, thus affording the plants a chance to become well rooted before the approach of cold weather. Protection with evergreen boughs the first winter is also suggested, and judicious pruning is attended with the most satisfactory results. In the spring, just before the buds start to grow, every tree should be carefully examined, and the dead wood, of which there is sure to be some, removed. If the specimens do not grow vigorously enough, give them more nourishment and cut them back severely. These are simple hints regarding their treatment, but nevertheless important; and if suggestions are carried out, success can be recorded in the future where failure has been experienced in the past. The best varieties for general use are as follows: The normal form or type, polymorphum, is a tree of small stature, medium growth, and regular outline, having rather

*A paper read by Mr. W. C. Barry, Mount Hope Nurseries, Rochester, by request before the American Association of Nurserymen, Florists, and Seedsmen, at their annual meeting, at St. Louis, June 30, 1883.

slender branches and small handsome foliage of a pleasing green color during the summer, but turning to a rich crimson in the autumn. This species is, I think, destined to become very popular. The variety sanguineum is a dwarf tree having rich red foliage, which holds its bright color till the middle of summer. During the months of June and July a plant of it is a very conspicuous and attractive object upon the lawn. Atropurpureum is another variety of moderate growth, having purple leaves, and when planted with the above produces an effective contrast. Atropurpureum dissectum has slender branches, which show a strong tendency to droop, and its leaves are delicately cut, resembling fern leaves, and of a beautiful purple shade. Japonicum is another very distinct species of medium growth with large, handsome, bright green leaves, the edges of which are scalloped. It grows more vigorously than polymorphum and its varieties, and bears some resemblance to the red Colchic maple. There are several other varieties and forms, but these are the most beautiful and useful. Now a suggestion with regard to the manner of planting. As these trees are what are termed slow growers, it takes some time for them to become effective; hence, we advise the planter to arrange them in groups consisting of three or six plants. A very satisfactory effect will thus be quickly realized, and every year the group will become more elegant and attractive. For several years the propagation of these maples has been conducted on a very limited scale, owing to the difficulty of procuring stocks to graft upon, and the price of plants has consequently been quite high. These obstacles having been removed, we may hope soon to obtain these beautiful dwarf trees at a moderate cost. Two new varieties of the Norway maple have recently been introduced from Germany, and promise to become important acquisitions. These are Schwedleri and Reichenbachii. Both have the vigorous, elegant, clean growth for which the type is so justly esteemed. Schwedleri has bronzed purple leaves, which appear to the best advantage during the spring time and early summer. As the season advances the leaves change to a duller shade, which is less attractive. But in this respect it differs little from purple-leaved trees generally, as they all lose their richest tints during the hot summer days. Reichenbach's maple is of quite recent introduction, and while its foliage lacks the richness and brilliancy of color for which Schwedleri is noted, its purple shade is more enduring, and lasts till late in the season. Lorberg's cut-leaved Norway maple is also quite new, but it does not differ enough from the old variety dissectum to be of much value; at least such is my opinion of it at present. Dissectum is a rare and handsome variety, and has always been scarce, owing to the difficulty which nursery men experienced in obtaining salable specimens, its growth being always more or less crooked. Lorbergi seems to be a better grower, and as it can be propagated more successfully, it may displace dissectum. Among cut-leaved trees both deserve our highest regard, as their leaves are deeply cut, and they form elegant specimens. Wooler's golden-leaved sycamore, a recent novelty from Germany, has superb yellow tinted leaves which render the tree remarkably showy in spring and early summer. Planted with purple-leaved trees the effect is charming. The yellow hue is not of the character which indicates lack of health; on the contrary, it has a richness and depth betokening extreme vigor. Still another interesting form of the Norway is the curled leaved. The leaves are of the usual size, but the lobes curl and turn inward in a curious manner, giving to the tree a unique aspect. This variety must not be confounded with the eagle's claw, from which it is very distinct. Acer tataricum glabrum is an ornamental variety of the Tartarian maple, of rather slender yet vigorous growth, rounded, regular form and having small or medium sized foliage. Its health, freedom from insects, hardness, and handsome appearance combine to make it a desirable addition to the list of small trees. Acer velutinum is a species brought to notice recently, but its origin I am unable to give. In general appearance it somewhat resembles the sycamore, but the foliage is thicker, of a dark green color, and the petioles are deep red. The impression I have formed after examining a small specimen is that it will prove to be a distinct tree of considerable merit.

Among other trees Memminger's horse chestnut is a comparatively new tree, having showy, pale yellow foliage, suffused or sprinkled with white. This shade, though peculiar, is effective and beautiful, and a well-developed specimen appears to fine advantage, especially in spring. Later on the delicate tints of its leaves fade under the effects of a scorching sun, and then it reverts to the ordinary form of the horse chestnut. Alnus illiacea is a noteworthy tree, having the foliage of a linden and the growth of an alder; indeed, few would recognize it as an alder. Its fine pyramidal form and rich, glossy, dark green foliage render it an elegant tree. The large, double-flowering almond, although it has been known to some extent for many years, deserves mention on account of its rarity. As a flowering tree it has few equals. A specimen about five years old is now in bloom in our grounds, and I cannot refrain from expressing my surprise that so valuable a tree should be so neglected. Every branchlet becomes literally covered with flowers of a delicate pink shade and perfectly double, like small roses. The double red, double pink, and double white flowering peaches are exceedingly showy and ornamental, and wherever seen elicit expressions of the highest admiration. How are we to account for their absence even in fine collections? Is it necessary to call them novelties in order to insure their recognition? At the present time I do not know any subjects more worthy of our attention, and I strongly urge their propagation and dissemination. Cerasus japonica rosea pendula, a weeping cherry from Japan, lately introduced, is destined to wide-spread popularity. Grafted standard high, its slender branches droop like those of the Kilmarnock willow, and form a symmetrical head which is sure to please admirers of this class of trees. As the Kilmarnock willow has become pretty generally disseminated, this introduction has enough merit to be ranked with it, and no doubt public appreciation will be shown in its behalf, and a large demand created for it. Cercidiphyllum japonicum is a distinct tree introduced lately from Northern Japan, where it is said to attain a large size. It is pyramidal in form, of vigorous growth, but slender and compact; foliage small, heart-shaped, and somewhat like that of the Judas tree. Specimens have stood out uninjured in our grounds for three years, and we have no doubts as to its hardiness. Its propagation is not easy, hence this promising addition will be rare for some time to come. Variegated-leaved tulip tree: We have in this variety similarity of likeness in all respects to the normal form except in the leaves, which are bordered with yellow, the effect of which is most pleasing. The young plants of it which we have seen promise to grow in beauty as they acquire age, and a large, well-grown specimen will without doubt prove a most interesting object to lovers of rare and curious trees. Phellodendron amurense, or Chinese



FIG. 1.



FIG. 2.

EXPERIMENT ON THE COMPRESSION OF AIR.

corn tree, comes from Manchuria, where it is said to attain the height of 60 feet. In general appearance and rapidity of growth it resembles the aiantus. Some authorities claim that it is destined to take the place of the aiantus, being possessed of all the valuable characteristics of that tree without any of its objectionable features. *Quercus concordia*, or golden oak, is a variety of the English which will undoubtedly prove to be a great favorite with planters as soon as it becomes better known. It is a rapid, vigorous grower, and its leaves are of a rich golden yellow color, even from the time they appear in spring; and they increase in richness as the season advances, assuming their most charming tints late in the summer and fall. The color is exceedingly grateful to the eye, and is so enduring that a specimen in perfection makes an impression which it is not easy to forget. Among golden-leaved trees there is certainly not another which can compare with it, particularly in autumn, and when planted near a purple-leaved tree the effect is grand. The fastigate birch is still a rare tree, although it was disseminated some time ago. It has the upright habit of growth and spiky, compact form peculiar to the Lombardy poplar; hence it is quite unlike any other birch. It will be found useful to give variety to a landscape, and can be employed where the poplar could not, owing to the size which the latter attains. A real gem among magnolias is *halleana* or *stellata*, which, though it was brought some years ago from Japan, is rarely seen. The Chinese magnolias, usually cultivated, are distinguished for their size and stately appearance, and are great favorites with the public on account of their remarkable flowers. *Halleana* is quite different from the other varieties, being of a dwarf habit of growth, and forming a symmetrical bush. Its blooms appear very early in spring, before those of any other magnolia, a fact which tends to give additional value to the plant for spring decoration. For the margins of groups or borders it will be found extremely useful, and it is sure to gain numerous admirers wherever it is disseminated. Van Geert's golden-leaved poplar has showy yellow foliage, which renders it a highly effective tree in groups. For a long time we questioned the value of this variety, but its bright and enduring shade makes it conspicuous, and we think it merits attention. The purple myrtle-leaved elm is a new variety of medium size, having small myrtle-like leaves of a dark purple color. The foliage is pretty and the color permanent. It has not been my good fortune yet to see large specimens, but, judging from small plants, I think we have in this novelty an addition of high merit. The color of the leaves is very much darker and more lasting than that of the old variety *Campesiris purpurea*. There are several other new and very promising kinds of elms with variegated foliage, but I will defer a consideration of them until they have been better tested. A very well defined and curious variety of the English elm is that called *monumentalis*. Its habit of growth is erect, compact, and its form conical, resembling, as its name implies, a monument. It grows slowly and can be employed in small grounds advantageously. *Ulmus Wredei aurea* is a golden-leaved elm, which bids fair to become very valuable. The leaves have a rich, warm yellow tint, which is permanent, and consequently a fine specimen arrests attention and commands admiration.

SHRUBS.

The common red dogwood is much esteemed by planters for winter decoration, on account of its dark red or crimson-colored bark. The variety to which I now draw attention is called *sibirica*, and its bark is of a bright red color. In the depth of winter the bark is brightest, and a single plant or several together form a most interesting feature in a garden. In the summer its beauty is also apparent, for the foliage is of a pleasing green color and the white flowers which it produces in spring are followed with purple fruit. This is not by any means a new shrub; nevertheless, it is rarely found. Its merits have been withheld from the public long enough, and I trust it will soon receive the recognition to which it is justly entitled. Shrubs of this character are doubly valuable, being ornamental and effective both in summer and in winter. The crimson and red branches of these two varieties when placed in contrast produce a very pleasing result. *Cornus sanguinea elegantissima*: In this we have a new claimant for public favor. Its origin I cannot give, but when in Europe ten years ago I found it in one of the nurseries, and was much impressed with its beauty and value. Fancy a red dogwood with handsomely variegated leaves, or rather having its leaves broadly edged with silvery white. *Cornus mascula variegata* has long been held in high regard on account of its distinctly variegated foliage. In some particulars this new variety of *sanguinea* will surpass it. The variegation is brighter and the shrub more rapid and less formal in its growth; hence it can be made use of in a greater variety of ways. As a new shrub of high promise it will certainly receive a great deal of attention. *Prunus pissardi*, or purple-leaved plum, is a novelty sent out from Paris last year. Its leaves are purple, the color is permanent, and I think this new plant will prove to be an acquisition. A pure white weigela of good habit of growth has long been sought after. During the last few years several so-called white varieties have been ushered into notice, but the flowers nearly always turned out to be bluish and frequently rose-colored. *Hortensia nivea*, the old variety, which bears pure white flowers, and which is comparatively well known to nurserymen and florists, has not been disseminated, being extremely difficult to propagate. Its habit of growth also is quite unsatisfactory. Hence *candida*, which is a strong upright grower and an abundant producer of pure white flowers, will at once be pronounced a desideratum. It has the additional merit of being a perpetual bloomer, flowers being upon the plants nearly all summer. Nurserymen will have no difficulty in obtaining a stock, as it can be easily propagated. Other new weigelas which appear to be very promising are *lavalleei*, a variety with reddish purple flowers, the darkest of any. Its habit, however, is loose and spreading. Edouard Andre, a later introduction, bears flowers of a very dark shade, and is a better grower. P. Duchartre produces flowers of a clear amaranth shade, which contrasts finely with the yellowish foliage of the plant. *Hendersoni* bears medium sized flowers of a red color. Both of these have a good habit and are free bloomers. *Spiraea crataegifolia* is not a new variety, but still quite rare. It resembles the well known lance-leaved in color, size, and form of the flower, but differs from it in foliage, and it has the valuable characteristic of being more hardy. I consider *lanceolata* a grand shrub, and in localities where it is hardy it comes out in spring, loaded with pure white blooms, and a large plant resembles a mass of snow, affording a striking contrast with the profusion of green which prevails at that season. But it often happens that much of the flowering wood becomes injured; hence an equally fine variety possessing greater hardiness will be an acquisition. I think we shall realize the improved form in *crataegifolia*. While on

this subject, I should not fail to refer to another improved variety of *lanceolata*, which has given much satisfaction. It is called *lanceolata robusta*, which appears to be more vigorous, hardier, and its flowers are larger. *Spiraea Van Houttei* is another form distinguished for its hardness.

There is another addition to the family of *Spiraeas*. It appears to be closely allied to the type *callosa*, and, like that species, does not grow large, but forms a symmetrical bush, and yields an abundance of flowers all summer. Its regular shape and small habit of growth will make it useful for borders of groups, and for planting singly on lawns of small extent. The golden *syriaca* is a most charming golden-leaved shrub. When planted alone or associated with other shrubs in a group, its bright and delicately tinted leaves create a pleasing effect. We now come to the consideration of one of the most important acquisitions made recently—*Xanthoceras sorbifolia*, this being the name of the new aspirant. It comes from Mongolia, or the center of China, where it was found by the Abbe David, and brought to Paris about 1868 by a Frenchman named Pichou. It is of medium size, forming a shrub or small tree not exceeding 10 feet to 12 feet high. Its leaves resemble somewhat those of the mountain ash, and its flowers are five-petaled, white, and reddish copper colored at the base and disposed in racemes. They appear in the months of April and May, about the time when the leaves are usually developed. The flowers are succeeded by fruit.

GIANT GRASSES OF AUSTRALIA.

DURING the periodical visitations of excessive drought that occur in many parts of the Australian continent, the greater portion of the vegetation is in many cases totally destroyed either by the drought or by bush fires, which devastate immense tracts of country. Such, however, is the tenacity of life in the *Xanthorrhoeas*, or "Black Boys," that, with the exception of shriveling up the green foliage and charring the stems, fires do not harm them, and excessive drought appears to be even favorable to their existence. Standing alone on dry, sandy plains, they are said to resemble sentinels in the distance, the leaves and flower-spikes having the appearance of the head and spear of a native "life-guardsmen." Although so tenacious of life, it has, however, hitherto been impossible to keep alive large specimens of these plants in this country for any length of time. A fine specimen of *X. arborea* was received at Kew about



AUSTRALIAN GRASS TREES.

ten years ago, but although it lived for some little time and produced a flower-spike, it never established itself, and it may now be seen in one of the Kew museums along with other specimens of the same genus, all of them retaining their leaves and flower-spikes in the most perfect condition. The finest living grass tree with which I am acquainted is in the College Gardens, Dublin. This is a healthy, large, well-grown specimen of *Klingia australis*, a near ally of the *Xanthorrhoeas*, and showing the same singular habit. There are several species of *Xanthorrhoea* in cultivation in European botanic gardens, but they are all very small, and as it takes some hundreds of years to produce such a specimen as that represented in the accompanying woodcut, our chance of seeing them of any great size under cultivation is exceedingly small. Australia is singularly poor in native edible fruits, to that the natives were driven to seek their food in the shape of esculents, such as fern roots, sweet potatoes, and the young heads of the grass trees. The gum exuded from the stems of the *Xanthorrhoeas* was also used by the natives for fastening the stone heads to the ends of their tomahawks. It is now used as incense in churches, for which its pleasant aroma when burning is said to make it well adapted. There are a dozen species of *Xanthorrhoea* known in Australia, some of which have a short stem, others one of from 8 feet to 10 feet in height. The plant here represented is *X. arborea*, one of the tallest species, with a flower-spike like a bulrush, and about 6 feet in length. The plant to the left in front of the grass tree is *Astellia Banksii*, a tall growing grass-like plant, sometimes found in large quantities in marshes, and sometimes growing on the trunks of gigantic trees. It grows freely in a cool conservatory in this country, and its pale green or silvery gnyerium-like leaves have a striking effect. Its flowers are not ornamental. The plant with tall, graceful flower-spikes appears to be *Arundo conspicua*, which, however, is known only in New Zealand in a wild state, where it is common in wet, marshy land. It is quite hardy in the south of England, and if happily situated it forms at least as great an ornament as the North American *pampas grass*.—*B. The Garden.*

WESTMINSTER Abbey, the world-famed monumental tomb of so much of England's greatness, is already crowded, not only with coffins, but with monuments. Mr. Shaw Lefevre suggests the erection, at a total cost of £130,000, of an additional chapel to be connected with the Abbey by a covered way. The scheme is a modification of a more ambitious one proposed by Sir Gilbert Scott some years ago.

WATER.

Notable Temperatures of Water.—32 deg. F. or 0 deg. C. the freezing point, under one atmosphere; 39 deg. F. or 4 deg. C. the point of maximum density; 62 deg. F. or 16 deg. C. the British standard temperature; 212 deg. F. or 100 deg. C. the boiling point, under one atmosphere.

The weight of a cubic foot of cold water is about 1,000 ounces, or 62.5 lb. The weight of a cylindrical foot of cold water, at 62 deg. F., is 48.973 pounds (about 49 pounds). The weight of one gallon of water, at 62 deg. F., is 10 pounds, and the correct volume is 277.274 cubic inches. The commonly accepted volume is 277.274 cubic inches. One cubic foot of water contains 6.2355 gallons, or approximately 6 1/4 gallons. The volume of water at 62 deg. F. in cubic inches, multiplied by 0.000036, gives the capacity in gallons. The capacity of one gallon is equal to one square foot, about two inches deep; or to one circular foot, about 2 1/2 inches deep. One ton of water, at 62 deg. F., contains 224 gallons. 1 cwt. of water = 11.2 gallons. 34.65 cubic inches or 1.25 lb. = 1 pint.

A pipe one yard long holds about as many pounds of cold water as the square of its diameter in inches.

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